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THE STREET RAILWAY CONVENTION.

The twentieth annual meeting of the American Street Railway Association held this week in New York City has been a success worthy the occasion and the opportunity. We write while the convention is still in progress and before all the work planned has received attention, but the excellent programme laid down has already been carried through with remarkable precision and vigor, and with a smoothness worthy the highest ideals of the organization. As to the exhibit in Madison Square Garden, it can only be characterized as marvelous for completeness, comprehensiveness and costliness, in view of the fact that it lasts virtually but three days. The Garden has seen many a show staged for a month on which far smaller effort and expense were put forth. Such an exhibit is a striking evidence in itself of the superabounding vitality and activity of the street railway industry. For ourselves, we are free to confess to a keen sense of pleasure in seeing the association return to a New York from which the horse and cable have now been virtually banished by electricity, and from which even now work is going on to exile steam. All those lower agencies have "had their day and ceased to be" in the field of urban traction, after doing useful work in their day and generation; and it is certain that the street railway art could not have attained its present magnitude and importance, but for their supercession by cheaper and cleanlier electricity. From the electrical standpoint, however, the conquest of the street railway field by electricity is but a preliminary to the subjugation of the main line steam railroads of the country, the beginnings of which revolution are already upon us.

THE PUPIN TELEPHONIC SYSTEM.

Elsewhere we print an interesting article by Dr. Pupin, in which he gives numerical and graphical illustrations relating to his system for reducing the attenuation and distortion of telephonic currents in cables and long land lines. To those who have been doubtful as to the practical application of higher mathematics to the direct solution of important industrial problems, the remarkable work of Dr. Pupin in this line should be a revelation. The true reason of the suspicion with which mathematics of the higher order has been regarded by practical men has probably been due to the fact that in the past those who have been adepts in mathematics were absolutely indifferent to its practical bearing, while the so-called practical man has either lacked higher mathematical training, or the skill to apply its methods. Since the day when William Thomson made his mathematical investigation of the constants of the submarine cable, and by showing thereby the entire feasibility of the project of the Atlantic cable, rendered its realization immediately possible, we know of nothing more brilliant in the same line than the recent work of Dr. Pupin in telephony.

The illustrations given by Dr. Pupin show how vitally the good results that may be obtained from the use of inductance in telephone lines, depends upon the proper distribution of the inductance along the line. In his several papers giving at length the theory of telephone wave propagation over conductors, Dr. Pupin showed that by a definite distribution of the inductance as fixed by the wave length corresponding to the highest important frequency in telephony, an ordinary telephone line may be made to approach in its transmission properties as near as desired to a distortionless line—that is, to the ideal line for telephonic transmission. The curves given elsewhere

indicate that for a distribution of inductance entirely practicable and little expensive, a correspondence of present telephone lines with the ideal one can be made so extremely close as to approach an identity. Those who look askance at the mathematical demonstration may be reassured as to its accuracy by the fact that the Pupin system has already been successfully applied on underground telephone circuits in at least one large city, with results which fully confirm its value with respect both to improvement in the transmission and enormous saving in copper.

MERCURY INTERRUPTERS.

Dr. Cunningham elsewhere in this issue describes what appears to be a simple and convenient revolving mercury interrupter for use in the primary circuit of a Ruhmkorff coil. The Wehnelt electrolytic interrupter, although very convenient for generating cathode rays in a Crookes tube, is apt to overheat and get out of order. When such an interrupter stops working, it is likely to allow unduly powerful currents to pass through it. The mercury interrupter here described appears to have the merit of breaking the circuit when it accidentally stops. Tesla has also favored the use of a particular type of mercury interrupter for generating high-frequency currents, and it is to be hoped that a cheap practical form of the apparatus may soon find its way into the market.

THEORY OF THE EDISON NICKEL-IRON CELL

In our correspondence columns appears an interesting letter by Dr. Roeber as a further contribution to the working theory of the new Edison storage cell. As soon as this cell is brought into commercial use, a careful analysis of its electro-chemical action is to be hoped for from those interested in such investigations. Up to the present time its distinguished inventor has apparently been so fully occupied in making the cell practically capable of doing industrial work that a complete analysis of its chemical reactions does not seem to have been made, and is no doubt a difficult matter. It would seem that neither the positive, nor the negative, active substance has yet been thoroughly analyzed. The one is supposed to consist, in the discharged state, of a mixture of oxides, or hydrated oxides, of iron. The other is supposed to consist, in the charged state, of a hyperoxide of nickel. Until these active substances have been fully analyzed at the stages of charge and discharge, no reliable working equations can be obtained. All that seems to be known is that for every active atom of iron, an atom of oxygen is transferred in charge or in discharge from one plate to the other. Dr. Roeber is no doubt right in assuming that concentration changes will occur during operation, in the deeper layers of the active briquettes. It would seem likely, in fact, that the steady decline in the discharging e. m. f. of the cell is due to such changes in the active material, by which the complete electro-chemical reaction is hindered and retarded. Just as in the Edison-Lalande cell, the migrating oxygen towards the end of discharge, has to penetrate a dense mass of already oxydized active material, in order to reach the interior layers of unoxydized substance.

THE BETTS LOCALIZATION TEST.

A method of localizing a fault in submarine cables by Mr. Walter Betts appeared in the London *Electrical Review* of August 16, and was noted in the Digest of Sept. 7. The conditions of the test are graphically exemplified by Mr. Raymond-Barker in an article appearing in the London *Electrical Review* for Sept. 13, and abstracted in the Digest of last week. Mr. Betts applies simultaneously two equal e. m. f.'s to the opposite ends of the cable (zinc poles to line) through measuring instruments, and determines from synchronous readings the corresponding resistance valuations of such readings. These successive pairs of resistance readings theoretically yield the electrical distance of the fault from each end of the line by a very simple formula. This method takes into consideration the polarization e. m. f. resident in the fault and also the instantaneous resistance in the fault, only requiring that the two testing e. m. f.'s shall be equal, and that the resistances of the measuring instruments and testing batteries shall be known. The method fails, however, to take into consideration the natural or earth current e. m. f. acting along the cable from one end of the line to the other, and theoretically the test should only be applied at such moments when the earth current e. m. f. between the two ends of the line is zero. On the other hand, the earth overlap localization tests in ordinary use, while not possessing the advantage of simultaneous readings from both ends of the line, and depending only upon alternate measurements from each end of the line, with the fault artificially thrown into the center of the circuit, take into consideration both the resistance and the polarization e. m. f. of the fault as well as such natural earth current e. m. f. as may exist at the time between the two testing stations.

SOME DANGERS OF AUTOMOBILISM.

The lamentable tragedy which robbed the Nation of its Chief Magistrate put a sudden end to many public functions and private amusements, among others to the automobile contest which was in progress at the time. Unfinished as it was, this contest had gone far enough to thoroughly demonstrate that it was representative of about every element that should by the principles of fair sport and the requirements of some engineering and good business be excluded from such a competition. As a technical journal we are seldom compelled to take a stand on sporting matters, but automobilism touches us rather nearly since some of the most successful machines are purely electrical in their equipment and their design and construction is a legitimate and growing branch of the electrical arts. And in this matter we are strongly inclined to the opinions, first that automobilism is not properly a branch of sport but a part of the far more important business of transportation in general, and, second, that in so far as it can be considered as a sport it is starting out along lines that are objectionable and likely to bring it into ill repute.

We have seen within the past 15 years the electric motor replace the horse on tramways so completely that in many States a horse car unless robbed of its motive power and set up as a night lunch stand could hardly be found with a search warrant. The few remaining lines are doomed to early extinction. We believe heartily in the future of the automobile, and that it is destined to replace animal traction to an extent which can as yet scarcely be realized. But we likewise believe that the automobile is a vehicle destined for work and for pleasure rather than for the race track, that it is destined to replace the truck and the cab and the trap rather than the sulky. For this reason we earnestly deprecate speeding as an important part of its early development. The electric automobile has more than once held up its end even in such trials, but as a serious practical business, an important factor in urban transportation, the electric hansom or delivery wagon is far more worthy of consideration. The great work in hand is the displacement of animal by mechanical traction, and to this the energies of inventors and manufacturers should be bent. A motor car with a possible speed of a mile a minute is a striking engineering feat, but it is not business, and its field of usefulness is a small and inconsequential part of the region that must eventually be tenanted by motor vehicles. Moreover, its exploits are more than likely to bring the whole art into ill odor even with a public as long suffering as the American public. It would not take much added provocation to start a campaign of

repressive legislation that would be most disastrous to the proper and normal growth of automobilism. Even now there are signs of such a tendency toward restrictions, which, to be effective, must necessarily be somewhat severe.

But granting for the moment that racing pure and simple is a legitimate part of automobilism, it still should be kept in the background rather than pushed to the front. No great and permanent business has or ever can have a firm basis in sport, particularly in an expensive form of sport. Even yacht building, in which Americans may certainly take a pardonable pride, has had many ups and downs, and commercially forms but a small part even of the somewhat decayed American ship building industry. The bicycle business is a case in point. Ten years has practically finished its life as an important branch of manufacture. Deserted bicycle factories dot the suburbs of many cities, and their owners may reckon themselves fortunate if they can be utilized for other industries. The bicycle was exploited primarily as furnishing a new and attractive sport, which grew, and then passed, in popular estimation. Now the wheel is mainly a convenience and source of recreation for working people, and as such worthy to be commended, but so far as sport is concerned, it has for the most part passed into the hands of a dwindling band of professionals humping their backs behind motor-pacing machines. If the growth of automobilism is to be along the line of sport there will be a boom followed by a certain collapse, which will seriously hinder the development of the automobile's real usefulness. Now, the test which formed the text for this industrial sermon, purported to be a trial of practical endurance, but it quickly tended to degenerate into a scorching match and the endurance was mostly in the hands of the express companies in the form of spare parts. Racing is well enough in its proper place, and tests of practical operative properties are always welcome, but this seems to have been, in the main, a tinkering match varied by periodical sprints. There will always be a small legitimate demand for racing automobiles and fast light motor vehicles for various purposes, but the backbone of the business will be the carriage and working wagons for steady, reliable service at moderate speeds. Toward the production of such vehicles the best energies of the manufacturers should be bent. Once they are in common practical use the racing feature can be trusted to take proper place, for the sporting blood of the normal American will assert itself, if he has to race wheelbarrows.

RESISTANCE IN THE VOLTAIC ARC.

Two very interesting papers on the c. e. m. f. of the voltaic arc have recently been communicated to the Royal Society of Great Britain, abstracts of which have appeared in the Digest. One is by Mrs. Hbrtha Ayrton, and the other is by Mr. W. Duddell. These papers represent opposing opinions and conclusions. Mrs. Ayrton believes that there is no active c. e. m. f. in the voltaic arc, and that there is only present the resistance of a mass of carbon vapor and a column of carbon mist, both having definite dimensions, and each having a definite resistivity. According to her view, the apparent c. e. m. f. of, say, 45 volts in the arc, is all IR drop, or fall of potential occurring in this resistance. Mr. Duddell adduces measurements, on the other hand, which lead him to believe that although some 75 per cent of the apparent c. e. m. f. is due to resistance, or represents IR drop, the remaining 25 per cent is real c. e. m. f., which he attributes to thermo-electric origin.

The question is a very difficult one to analyze. With 45 volts p. d. between the carbons, there is nothing to show, on the surface, how much of this is c. e. m. f., like that in a storage cell, and how much is drop in resistance. Moreover, if we keep the length of the arc constant, and increase the current strength, we usually *diminish* the p. d. between the carbons, as though there were a negative resistance. This anomalous condition is generally admitted to be due to secondary changes in the arc, following the change in current. Duddell says, in fact, that if the current strength through the arc is varied by only three per cent, a secondary change in the arc will be thereby set up in one ten-thousandth part of a second. Consequently, all reliable resistance measurement would have to be made in less than that interval of time after changing the current. Mrs. Ayrton points out the same thing.

Mr. Duddell consequently resorted to a very high-frequency alternating-current, superposed upon the direct current of the arc, and made measurements on the alternating component. He claims to have reached a frequency of 120,000 cycles per second, which corresponds to an ether wave of 2½ kilometers in length. At such an enormous frequency, ordinary short coils of wire, by reason of their inductance, behaved more like insulators than conductors, and special measuring apparatus had to be designed. The results given are, that in the case of a 3-millimeter arc between solid carbons, carrying 9.91 amperes, 37.8 volts were due to resistance, and 12 volts to c. e. m. f. at the crater, making 49.8 volts total apparent c. e. m. f. It is intimated that if the carbons were chemically pure an indefinitely high e. m. f. would be necessary to maintain the arc; or, in other words, that the maintenance of the carbon voltaic arc at the ordinarily observed pressures is due to small impurities in the carbons. Cored carbons are carbons rendered deliberately impure in their central portions, in order still further to lower the e. m. f.

Mrs. Ayrton studied the arc by the aid of optical methods. She points out that close beneath the crater is a colorless space probably containing volatized carbon, or carbon vapor. Beyond this space is a purple column probably containing this vapor in a condensed state like mist, and outside of all is a yellow cover or sheath of flame, consisting of burning gases. Since the flame seems to be an insulator, the conductive path is limited to the carbon vapor and carbon mist. The former seems to have a higher resistivity than the latter. By studying the forms of these columns in the optical projection of the arc, with varying current strengths and lengths of arc, formulæ for resistance are developed of the same algebraic form as those derived from previous experimental researches upon the total c. e. m. f. apparent in the arc. Consequently, Mrs. Ayrton considers that there is no necessity to introduce any hypothesis of active c. e. m. f., and that mere resistance will account for all the observed facts.

In comparing the opposing deductions of these two researches and observers it is well to remember that some e. m. f., or c. e. m. f. of thermo-electric origin is to be expected in the arc. That is to say, it would be reasonable to suppose that a mass of highly heated vapor between two carbon electrodes at high but different temperatures would be likely to give rise to some residual thermo-electric e. m. f. It would not be probable at first sight, however, that such an e. m. f. would be more than a volt or so, considering how small are the e. m. f.'s met with in single thermo-electric couples. Duddell's measurements seem to indicate c. e. m. f.'s up to 17 volts in the crater. It is possible, however, that using such enormous frequencies of testing current, there may be some undetected error in his measurements. Until the matter is further investigated, we should incline to the belief that the truth lies somewhere between these two sets of results, namely, that there are small thermo-electric e. m. f.'s or c. e. m. f.'s at the electrodes, and that the great bulk of the apparent p. d. is due to resistance in the column of carbon vapor and mist.

Electricitv for Heavy Trains.

As already hinted in these columns, the investigations for the Great Northern Railway into the matter of substituting electric for steam power for railroad use under the direction of J. N. Hill, the eldest son of President J. J. Hill, have convinced both of these gentlemen that there is a great saving to be made in operating trains by water power conveyed in the form of electricity.

When the plan was first broached it merely contemplated the operation of trains by electricity through the Cascade tunnel, a distance of about 2½ miles. But now the electric improvement will be applied to that portion of the road extending from Leavenworth on the east side of the mountains, to Skykomish on the west side, 66 miles. It is understood that if the electric motors are a success they will be immediately operated from Everett on the west side to Wenatchee on the east side, a distance of 141 miles, and eventually extendd to include the entire mileage of the system.

The portion of the road chosen for the first application of the experiment in electric power is one of the most difficult and expensive portions of the road to operate on the entire system. It lies through the wild and rugged Cascades, the grades are very heavy on both sides of the mountains, there are many miles of snowsheds, and every winter there are numerous slides of earth and rock, which come down from the steep mountain sides to cover up the tracks and endanger the operation of trains.

There is one important reason why the Great Northern desires to secure and adopt some new and cheaper motive power for this portion of its system, and that is because of the expense of coal, which gives both the Oregon Railway & Navigation Company and the Northern Pacific a great advantage over the Great Northern in the expense of handling freight on its coast division.

The advantage of the Oregon Railway & Navigation Company lies in its gravity route down the Columbia River from the Rock Mountains, and that of the Northern Pacific lies in hte fact that it mines its own coal at Roslyn at a cost of from $1 to $1.25 a ton, while the coal of the Great Northern costs about $2.75 for the ordinary product, which is used on the greater portion of the division, and for the Crows Nest Pass coal, which is used on all trains through the tunnel, the cost is much greater.

For about 30 miles of the mountain climb on the Cascade division each loaded train running over it requires the asistance of a helper engine in addition to the regular engines, and as all of the mountain trains are hauled by the big mountain-climbing engines the coal consumption is something enormous, amounting to upward of 250 tons a day, or nearly a million tons a year. At a difference of $1.50 a ton in favor of the Northern Pacific it will be seen that he older road has, on account of coal supply alone, a considerable advantage over its newer rival.

As the water power for the creation of the electric power for the operation of the trains under the new system will be taken from one or more oft he many streams which exist in abundance along that portion of the system the innovation contemplated will reduce the coal bills of the division very greatly, if not eventually doing away with them entirely.

Electrical Engineers of the Day—XV.

Charles T. Malcolmson.

Charles Tousley Malcolmson, the chief engineer and manager of the department of machinery and electricity for the South Carolina Interstate and West Indian Exposition to be held at Charleston this winter under State and National auspices, is a graduate of the Armour Institute of Technology, of Chicago, with the degree of electrical engineer. He was born at St. Thomas, Ont., Canada, Jan. 31, 1872, and graduated from the Collegiate Institution at London, Ont., before going with his relatives to Chicago. At the Armour Institute he held the record in mathematics and physics, as well as being prominent in Institute and fraternity matters. After graduation, he spent a year in the electrical factory of the Mather Electric Company in Connecticut, proceeding then to Chicago again, where he became superintendent of construction in the huge packing house of Nelson Morris & Co. During the period of the Chicago World's Fair, Mr. Malcolmson made a study of the methods of exposition intsallation, and at its close engaged in design and testing work, this including an elaborate fuse wire test of six months' duration for the Chicago Fuse Wire Company. About this time he made the acquaintance of Mr. C. B. Davis, the well-known hydraulic engineer and became associated with him in the construction of the water works system for Anaconda, Mont. Here Mr. Malcolmson's work included the design of a complete central station steam power plant to operate the lighting and street railway system at a cost of $200,000, and he also laid out plans for a $2,000,000 power transmission plant for the Washoe and Anaconda smelters. He was offered a position as designing engineer with the Anaconda Company at Butte, his work there involving the construction of two large compressor plants, a pumping station, etc., and a lighting plant. He was put in charge later of the drafting room at Anaconda, but while on a visit to Chicago in 1899, met Mr. F. E. Drake, who had been made director of machinery and electricity for the United States at the Paris Exposition, and who tendered to Mr. Malcolmson the position of chief engineer to the United States Commission. The offer was promptly accepted.

Those who visited the Paris Exposition and studied the American exhibit are familiar with the thoroughness with which Mr. Malcolmson did his work under most trying conditions, the obstacles including not only those always incident to such work, but the loss of much plant and structural material at sea, at a vital stage of the construction in Paris. Mr. Malcolmson made the plans and calculations for the famous American Machinery Building at Vincennes and for its plant and the operation of its exhibits, by steam, electricity and compressed air, and had the satisfaction of seeing it eagerly com-

peted for and bought up—lock, stock and barrel—at the close of the Exposition. In addition to this, Mr. Malcolmson had supervision of all the mechanical design and construction, etc., connected with the United States Government Building in the Champ de Mars, the American work in the electrical and machinery buildings, and the general engineering work connected with the Government exhibits, throwing upon him a bewildering and complicated mass of detail. For a time he served as active director of the mechanical and electrical department, in Mr. Drake's absence. He was also appointed a member of the International Jury of Awards in the class of electrical generators and transmission. At the close of his duties, he was most warmly complimented by the head of the United States Commission and his direct chiefs on the success that had attended his efforts.

On his return to this country a few months ago, Mr. Malcolmson proposed to accept some one of the positions in the electrical engineering field that awaited him, but having been recommended to the South Carolina Exposition authorities he assumed at once the duties of chief engineer, and is now engaged very actively on the necessary construction and equipment work of a large plant as well as in the preparation of some interesting illumination and fountain effects.

Mr. Malcolmson has not at any time been active with his pen, but on the other hand has found pleasure and recreation in artistic pursuits. While at Anaconda he modeled a plaque which was executed by the Gorhams and was presented by the city to Mrs. Phoebe Hearst, of California, in recognition of a library that she had given to the community. For the Paris Exposition, he designed the handsome lamp-post for arcs, which was a conspicuous feature of the American electrical and machinery exhibits.

The Bay Counties, California, Power Transmission System, Colgate Plant.

IN the past ten months a number of articles have appeared in these columns giving some of the features of the operation of many extensive and interesting long-distance power transmissions in the far West. As was apparent to the readers of those articles, there has been a great activity in this line of work in the past five years. Commercially the results have been such as to justify longer and longer transmissions and larger investments per horse-power developed. The highest voltage line in commercial use up to April 27, 1901, was 40,000 volts, which is the pressure employed by the Telluride Power Transmission Company on its 105 miles of line supplied from its Provo Cañon power house in Utah. Two large companies now have pole lines running into Oakland, Calif., each of which was built for a line pressure of 60,000 volts. Both of these companies have transmission lines for conducting power a greater distance than any previous undertaking. The first of these to go into service was the line of the Bay Counties Power Company, 142 miles in length from Colgate on the North Yuba River southwest to Oakland, Calif., on April 27, 1901. The Bay Counties Power Company began to transmit over this 142-mile line at a pressure of 40,000 volts. All plans are laid to increase this to 60,000 volts when the line losses due to the increased load are sufficient to justify it.

The Bay Counties Power Company is a consolidation of two companies formerly doing business in Yuba and Nevada counties. The system includes in all three power houses, but the main generating station is the new Colgate plant, the completion of which now makes possible the presentation of the accompanying views of this interesting work. In the ELECTRICAL WORLD AND ENGINEER of Feb. 16, 1901, a brief outline was given of the work under way on the transmission system of the Bay Counties Power Company in California. In the issue of June 8, 1901, R. H. Sterling, superintendent of the Bay division of this company, described fully the long 4427-ft. span by which the transmission lines cross the Straits of Carquinez, the towers and enormous strain insulators used for this purpose being well illustrated in the article.

The Bay Counties Company, as before said, transmits 142 miles from its Colgate power house on the North Yuba River to Oakland, and it is also temporarily selling power to the Standard Electric Company of California, which has a line completed between Oakland and San Jose, and will ultimately transmit power from a point in the mountains almost due east of San Jose, to San Jose and thence to Oakland. The power which is being sold to the Standard Electric Company is transmitted over the Standard lines from Oakland to San Jose, making a total distance over which power is transmitted from Colgate to San Jose, 184 miles. The transmission in either case is the longest yet carried out commercially for any length of time. The voltage is 40,000 volts, and the form of Locke insulator was described and illustrated on page 760 of the ELECTRICAL WORLD AND ENGINEER of May 19, 1900. It consists of a porcelain umbrella 12 inches in diameter mounted on a glass insulator 12 inches high with a very long petticoat. The joint between the coils and the porcelain is made with sulphur and sand. The insulators of this company's line are mounted directly on bare wooden pins. The Standard Electric Company, which uses the same insulator, has placed a porcelain sleeve around the pin between the insulator and the crossarm with the idea that this would tend to prevent the burning of the pin through small leakage from the petticoat of the insulator to the pin.

The pole line construction of this company was lately described by C. E. Dutcher before the last convention of the Pacific Coast Electric

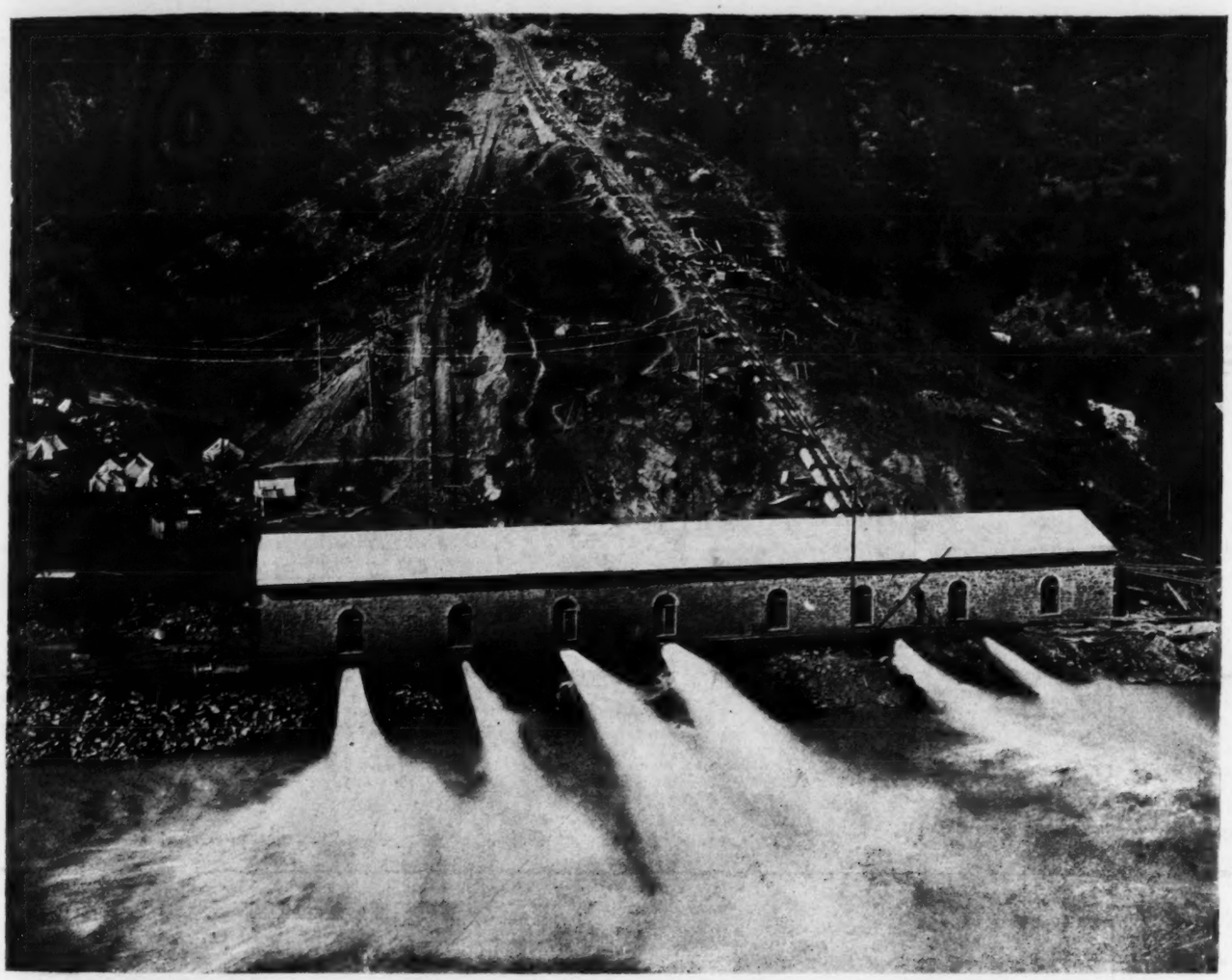


FIG. 1.—EXTERIOR COLGATE POWER HOUSE.

Transmission Association at San Jose. To secure continuous and successful operation, a double-pole line was erected the entire distance of 142 miles from the company's largest power house at Colgate, to Oakland, so that should one line be interfered with the service could be continued over the other. The poles used for this line are round Oregon cedar in lengths of from 25 to 60 ft., with tops from 8 to 12 inches and butts from 12 to 18 inches in diameter. Twenty-five-foot poles are placed 5 ft. in the ground, and 60-ft. poles 8 ft. in the ground. At angles the poles are set 1 ft. deeper in the ground than this. They are shaved over the entire surface of the top to a point 6 inches below the bottom cross-arm, and painted with a dry paint applied hot. The butts are saturated with hot carbolineum from 1½ ft. above the ground line to 2½ ft. below the air line. Each pole line carries three wires on a three-phase circuit. Wires form an equilateral triangle 36 inches on a side. At transpositions the distance apart of the insulators is increased to 42 inches. Transpositions take place every mile and consist of one-third of a turn. One of the pole lines carries three No. 00 hard-drawn copper wires, and the other pole line No. 0000 7-strand aluminum cables. The joints in the copper lines are of the regular Western Union type with nine wraps on each side soldered the entire length. Joints in the aluminum line are made by thimbles, one screwing into the other and the cable held inside the thimble by the wedging of the wires in the taper bore of the thimble. The telephone lines are not transposed at any point the entire distance.

The company has three power houses, but the principal and newest one is that which it is now possible to illustrate, which is situated at Colgate on the North Yuba River. This plant has a capacity of 15,000 horse-power, and contains three units of 3000 horse-power and four units of 1500 horse-power. The generators are three-phase, 60-cycle, built by the Stanley Electric Manufacturing Company, and direct-connected to Risdon Iron Works impulse waterwheels governed by Lombard governors. This immense power house is one of the most picturesque in its location of any in the West, as can be seen by the accompanying views, which show not only the power house but the surrounding mountains and the flume and pipe lines which supply the water. The flume terminates at a point on the hillside 700 ft. above the power house. Thence five pipe lines are laid down the mountainside to the power house receiver. Each of these pipe lines is 30 inches inside diameter. At the bottom they are cast-iron and at the top steel. The flume supplying the water is 7.6 miles long, the drop is 13 ft. to the mile, and it is 7 ft. wide and about 6 ft. deep. The power house building is 275 ft. long by 40 ft. in width. An excellent general view of the power house, pipe line, penstock, flume and surroundings is shown in Fig. 1. Details of the work shown in general in Fig. 1 are given in Figs. 3 to 8. Fig. 4 is a view of the interior of the power house showing the line of generators and waterwheels. One of the waterwheels and controlling mechanism is illustrated more fully in Fig. 7. The pipe line is anchored very securely just above the power house, as can be seen from the general and exterior view of the power house in Figs. 1 and 2, and also more in detail in Fig. 5. Figs. 1 and 2 also show the streams of water issuing from the deflecting nozzle of the wheels.

FIG. 2.—GENERAL VIEW SHOWING FLUME TO COLGATE.

The head of water available at this plant being 700 ft., it is, of course, impracticable to govern the waterwheels by throttling the water supply delivered by the pipe lines. The column of water coming down the pipe line at 700 ft. head should be considered as analogous to a solid body of that weight and moving at the velocity of the water. Any attemp to suddenly check the flow of a column of this kind could only result in the destruction of the pipe line because of the immense quantity of live energy in the high column of moving water. It goes without saying that care must be exercised in handling a hydraulic plant under such heads, and slight carelessness in this respect has resulted very disastrously in some California high-head plants. Although the head in the present case is only about half that used in some other

FIG. 3.—TWO MILES OF FLUME.

FIG. 4.—INTERIOR OF COLGATE POWER HOUSE.

COLGATE PLANT, BAY COUNTIES POWER COMPANY.

plants in that State, great care must be taken even at a 700-ft. head. This is well illustrated by the streams issuing from the nozzles in Fig. 2, which are sufficient to throw water clear across the river. Fittings of waterwheels around such heads as this are likely to wear out rapidly, especially if the water has dirt or grit in it, and leaks are

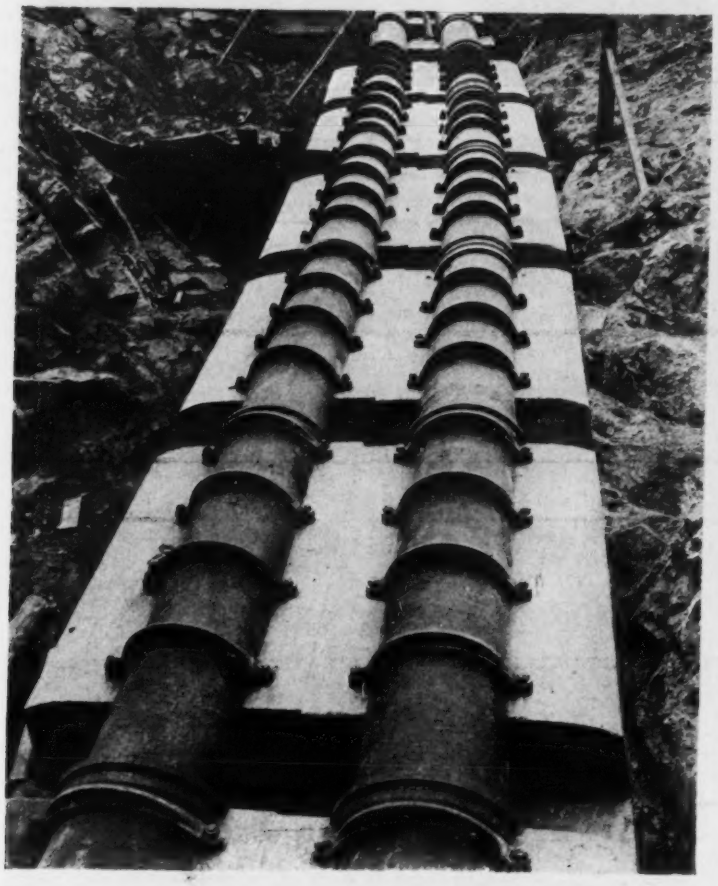


FIG. 5.—30-INCH CAST IRON PIPE AND ANCHORAGE.

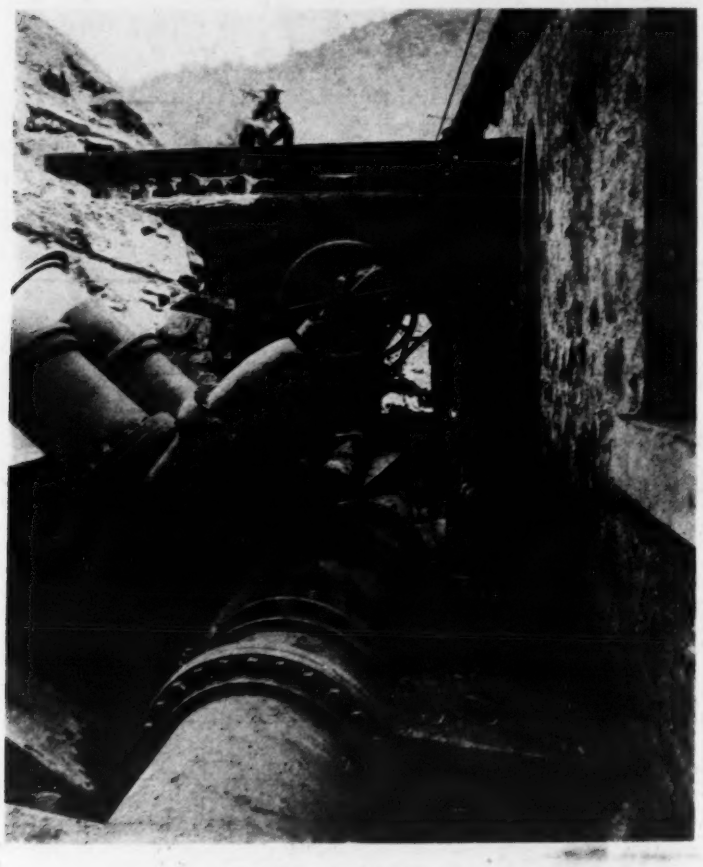


FIG. 6.—RECEIVER AND GATE VALVES.

very much the effect of drills on any surface they strike against. The only thing that can be done in a hydraulic plant of high head is to so design the parts against which the water will strike that they will be least injured by the stream, and provide for their frequent renewal.

The penstock at the head of the pipe line is shown in Fig. 8. Each

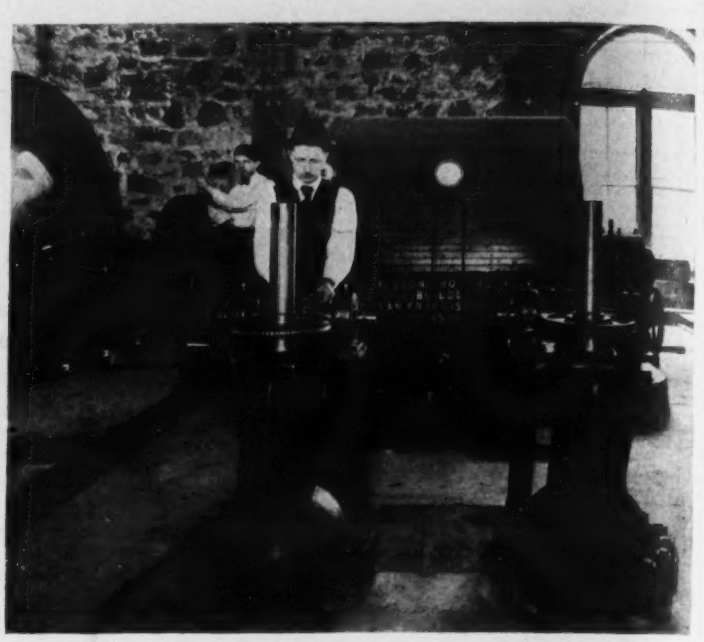


FIG. 7.—3000-HP WATERWHEEL.

of the five pipes has an air vent at this point. At the foot of the pipe line each pipe enters the receiver at the power house through gate valves. Fig. 3 shows two miles of the flume.

The method of driving exciters adopted in this power house is of more than usual interest and is the idea of T. E. Theberath, superintendent of the Yuba Division. Exciters driven from the main generators are open to the objection that any drop in speed of the main generators causes the exciters to drop in voltage, and this in turn lowers the voltage delivered by the generator exactly at the time when, if anything, increased voltage is needed. On the other hand, when the exciters are driven by independent waterwheels, as is usually done, there is some liability that the small nozzles employed on the small waterwheels driving the exciters will be clogged. That is, there is more danger of this than with the larger waterwheels driving the main generators.

In the Colgate power house the following method is used: A 50-hp exciter is driven by a 50-hp impulse wheel. Coupled directly to the other end of the waterwheel shaft is a 50-hp induction motor. This motor is connected directly to the 2400-volt bus-bars of the station. The waterwheel of the exciter is run with its valve open as for full load at all times. When less than full load is on the exciter the induction motor acts as a generator delivering energy to the main bus-bars. If the water supply for any reason is interrupted on the exciter waterwheel, the induction motor drives the exciter as if noth-

FIG. 8.—PENSTOCK AND FOREBAY.

ing had happened. In fact, this very thing has occurred. This is a novel solution of the problem of driving exciters in waterwheel plants, and one which is likely to be followed elsewhere.

A Note on Loaded Conductors.

BY M. I. PUPIN, PH.D.

IN my publications on wave propagation over non-uniform conductors it was shown that such conductors act approximately like their corresponding uniform conductors when the number of loads per wave length is sufficiently large. Sixteen loads per wave length was shown to be so close an approximation that experimentally no difference could be detected between the non-uniform conductor and its corresponding uniform conductor. It was also shown, experimentally, that with a small number of, say, four loads per wave length the resemblance between the two is small, and the efficiency of transmission over the non-uniform conductor is very much diminished in spite of the increased inductance. In other words, when the number of loads per wave length is small

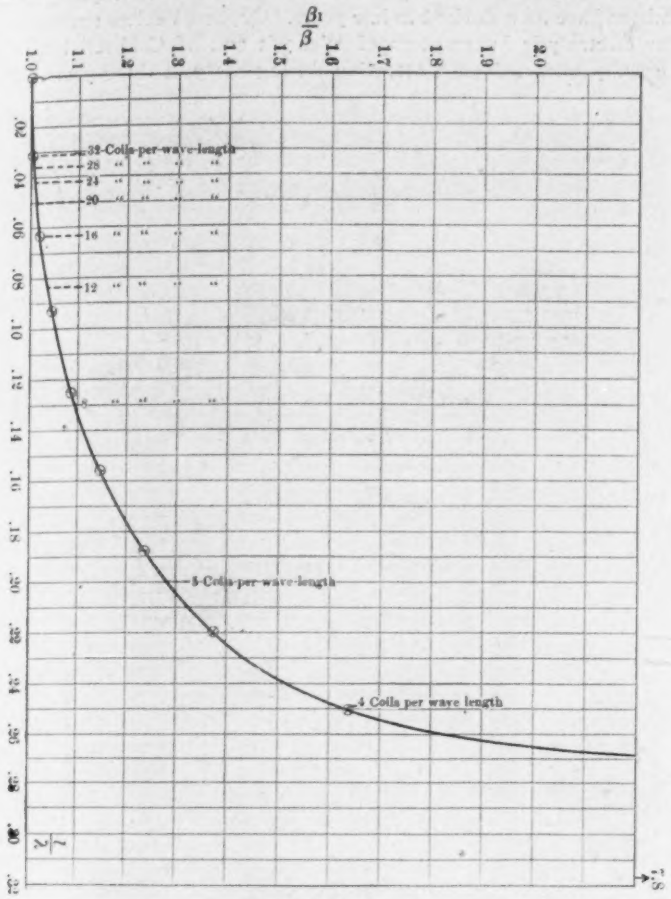


FIG. 1.

the loaded conductor becomes an inefficient transmitter and, therefore, the loading is poor.

It is proposed to show in this note, numerically, the action of a poorly loaded conductor by comparing, numerically, its propagation constants to those of the corresponding uniform conductor. Numerical calculation can be readily made by formulæ deduced in my two papers referred to below. The two types of loaded conductors will be considered separately. The first type was discussed in Section II. of my paper on "Propagation of Long Electrical Waves," *Transactions* of the American Institute of Electrical Engineers, Vol. XV. (March 22, 1899). The second type will be found in a paper read by me before the American Mathematical Society, Dec. 28, 1899, and published in the *Transactions* of that society, Vol. 1, No. 3. The behavior of these two types of conductors will be found to be the same under all conditions which can arise in ordinary practice.

A. LOADED CONDUCTOR OF THE FIRST TYPE.

In this case wave propagation is expressed in terms of a complex angle $\theta = \frac{1}{2}(a_1 + i\beta_1)$ which is defined by the following equation:

$$h = -4 \sin^2 \theta \; * \qquad (1)$$

which can be also written

$$\sin\theta = \sin\frac{1}{2}(a_1 + i\beta_1) = \frac{1}{2}(a + i\beta) \; ** \qquad (2)$$

* Propagation of Long Electrical Waves; *Transactions* of the American Institute of Electrical Engineers, Vol. xv, p. 144.

**Same paper, p. 151.

This equation determines completely the propagation constants a_1 and β_1 of the loaded conductor in terms of the propagation constants a and β of the corresponding uniform conductor.

For numerical calculations the real and the imaginary parts can be easily separated, thus

$$\left.\begin{aligned} \cos h\frac{\beta_1}{2}\sin\frac{a_1}{2} &= \frac{a}{2} \\ \sin h\frac{\beta_1}{2}\cos\frac{a_1}{2} &= \frac{\beta}{2} \end{aligned}\right\} \qquad (3)$$

or what is the same thing

$$\left.\begin{aligned} \cos\frac{a_1}{2} &= \frac{1}{2}\sqrt{\frac{1}{2}\left\{\sqrt{[4-(a^2+\beta^2)]^2+16\beta^2}+[4-(a^2+\beta^2)]\right\}} \\ \sin h\frac{\beta_1}{2} &= \frac{1}{2}\sqrt{\frac{1}{2}\left\{\sqrt{[4-(a^2+\beta^2)]^2+16\beta^2}-[4-(a^2+\beta^2)]\right\}} \end{aligned}\right\} \qquad (4)$$

B. LOADED CONDUCTOR OF THE SECOND TYPE.

In this case wave propagation is expressed in terms of a complex angle $\psi_s = \frac{1}{2}(a_1 + i\beta_1)$ which is defined by the following equation:

$$\sin\psi_s = \sin\frac{1}{2}(a_1 + i\beta_1) = \frac{1}{2}\frac{l}{\kappa+1}(a_s^{1} + i\beta_s^{1})^{(1)} \qquad (5)$$

that is, provided the distance between the loads is sufficiently small in comparison with the wave length on the conductor before it is loaded. This provision imposes no serious limitation since this wave length is five to ten times longer than the wave length on the corresponding uniform conductor. Equations (5) and (2) are identical, so that the second type of loaded conductor does not differ from the first.

In preparing the numerical tables from which the curves in Fig. 1

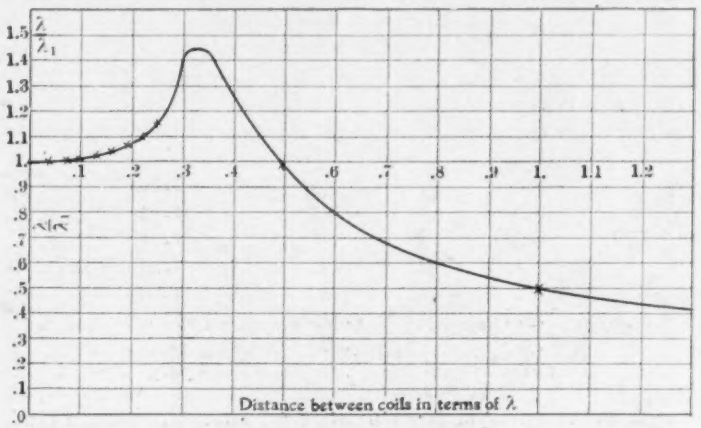


FIG. 2.

and Fig. 2 were plotted much labor is saved by considering separately the values of $\cos\frac{a_1}{2}$ and $\sin h\frac{\beta_1}{2}$ in the following three intervals:

First interval: The quantity $4-(a^2+\beta^2)$ is considerably greater than zero.

Since β^2 is very small in comparison with unity equations (4) reduce to

$$\left.\begin{aligned} \cos\frac{a_1}{2} &= \sqrt{1-\left(\frac{a}{2}\right)^2} \\ \sin h\frac{\beta_1}{2} &= \frac{\frac{\beta}{2}}{\sqrt{1-\left(\frac{a}{2}\right)^2}} \end{aligned}\right\} \qquad (6)$$

Second interval: The quantity $4-(a^2+\beta^2)=0$ very nearly. Equations (4) reduce to

$$\left.\begin{aligned} \cos\frac{a_1}{2} &= \sqrt{\frac{\beta}{2}} \\ \sin h\frac{\beta_1}{2} &= \sqrt{\frac{\beta}{2}} \end{aligned}\right\} \qquad (7)$$

Third interval: The quantity $4-(a^2+\beta^2)$ is considerably smaller than zero.

[1] M. I. Pupin, Wave Propagation Over Non-Uniform Electrical Conductors; *Transactions* of the American Mathematical Society, Vol. I, No. 3, p. 276.

Equations (4) reduce to

$$\left.\begin{aligned} \cos\frac{a_1}{2} &= \frac{\frac{\beta}{2}}{\sqrt{\left(\frac{a}{2}\right)^2 - 1}} \\ \sin h\frac{\beta_1}{2} &= \sqrt{\left(\frac{a}{2}\right)^2 - 1} \end{aligned}\right\} \quad (8)$$

A brief explanation of the symbols is desirable. Let l be the distance between the loads on the loaded conductor of the second type. It will be the length of the corresponding uniform conductor which is equivalent to one coil of the loaded conductor of the first type.

Let λ be the wave length on the corresponding uniform conductor.

Let λ_1 be the wave length on the non-uniform conductor.

Then $a = \frac{2\pi l}{\lambda}$ = angular distance on the corresponding uniform conductor,

$a_1 = \frac{2\pi l}{\lambda_1}$ = angular distance on the non-uniform conductor.

$\beta^1 = l\beta$

$\beta_1{}^1 = l\beta_1$

where β^1 and $\beta_1{}^1$ are the attenuation constants on the non-uniform and its corresponding uniform conductor, respectively.

In the following table the ratios of the wave lengths $\frac{\lambda}{\lambda_1}$ and of the attenuation constants $\frac{\beta_1{}^1}{\beta^1}$ of the loaded conductor and the corresponding uniform conductor are given for various distances between the loads, these distances being measured in terms of the wave

TABLE.

$\frac{l}{\lambda}$	$\frac{\lambda}{\lambda_1}$	$\frac{\beta_1{}^1}{\beta^1}$
.0313	1.001	1.005
.0626	1.009	1.02
.094	1.015	1.047
.125	1.029	1.088
.1565	1.045	1.15
.1788	1.071	1.24
.22	1.093	1.38
.25	1.15	1.64
.318	1.443	7.8
.5	.986	40
1.0	.5	34.5

length on the corresponding uniform conductor. The column headed by $\frac{l}{\lambda}$ contains these distances. The curves in Fig. 1 and Fig. 2 were plotted from the above table.

These curves were calculated for the conductor described in my paper read before the American Institute of Electrical Engineers May 18, 1900. For this conductor

$$\beta_1{}^1 = .0141$$

It is evident that up to about four coils per wave length they will hold true for any loaded conductor that may occur in practice.

Observe the rapid increase in the attenuation constant of the loaded conductor as soon as the number of coils per wave length becomes less than six. It is dangerously high at four coils per wave length and may be anything if that number is between 4 and π.

Observe also that the wave lengths of the loaded conductor is a definite quantity only as long as the conductor is properly loaded. On a poorly loaded conductor the wave length may be either smaller or greater than the wave length on the corresponding uniform conductor.

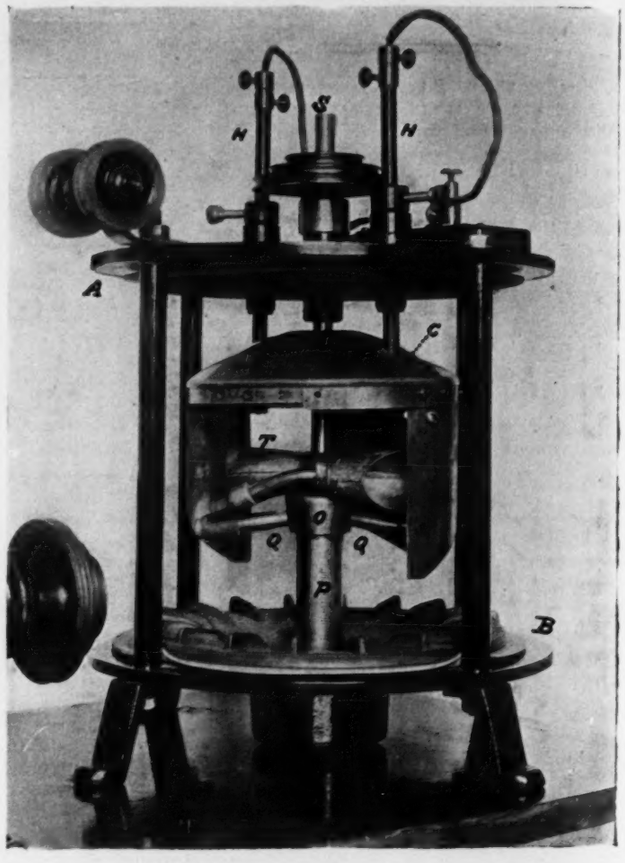
Electric Fans in Mines.

Owing to the successful use of electric fans in the lower levels of the Comstock mines, Virginia City, Nev., cross cutting can soon be resumed in the 2150-ft. level of the Consolidated California & Virginia.

A Simple and Efficient Mercury Jet Interrupter for Röntgen Ray Induction Coils.

BY R. H. CUNNINGHAM, M. D.

AS is well known to every one who has had any practical experience in the use of the induction coil for actuating Röntgen ray tubes, an extremely important and often trouble-giving part of the apparatus is the interrupting device required to rythmically make and break the current energizing the primary of the coil, especially when the current is drawn directly from the usual 110 or 220-volt continuous current. Thus, in order to obviate the well-known difficulties, such as flaming, sticking and imperfect interruption, that usually occur when induction coils supplied with the old style vibrating spring contact breaker are energized by currents at the above mentioned voltages, almost numberless interrupting mechanisms have been devised in late years. Of these devices undoubtedly the electrolytic interrupters of Wehnelt and of Caldwell have deservedly attracted most attention during the past three years. But



MERCURY JET INTERRUPTER.

even these have their drawbacks, and when they are in action are extremely objectionable to some people, owing to the terrific noise produced and to the evil smelling, irritating fumes which are generated. Furthermore, these electrolytic devices require careful adjustment before they will begin to work, and even under the best conditions irregularities in their action frequently occur. Sometimes also, just in the midst of Röntgen ray exposure they unexpectedly explode, possibly causing a large, expensive photographic plate, and still more valuable carpets and furniture, to be spoiled and rendering the outfit useless until the interrupter is repaired. In order, therefore, to obtain a comparatively quick, frequent and regular interruption of the primary circuit unaccompanied by the above-mentioned objectionable features, and without excessive sparking, it occurred to the writer some months ago that the improved and simplified form of mercury jet interrupter described below would probably function almost ideally.

Unlike the well-known German turbine mercury jet interrupter and that of Boas, it contains no fluid non-conductor, such as alcohol or oil, which prolong the arc at the break, rapidly carbonize and con-

taminate the mercury, and are in great danger of catching fire if heavy currents are employed. It has no fixed brushes to convey current to moving parts, and when it is desired to vary the duration of the make without altering the period, thus varying the intensity of the primary current employed, the necessary adjustment can readily be performed from the exterior, which obviates the frequent opening of the apparatus and the constant risk of inhaling at such times more or less deleterious mercury vapor. Like other mercury jet interrupters, the mercury in time becomes contaminated by a certain amount of oxide and metallic mercury in the form of very fine dust, and when this dust has accumulated in sufficient quantities after five or six weeks' usage, it may readily be removed and placed in the usual iron mercury still and on distillation yields the original liquid mercury.

The plan and the mode of action of the interrupter can be understood readily from the accompanying illustration, in which the interior of the apparatus is shown after the removal of the containing cylinder and one leaf electrode.

Referring to the figure, *B* is a round, hat-shaped iron bottom, which is flanged on the upper surface near the periphery and rests upon legs by which the apparatus can be firmly screwed to a base board or a conveniently located shelf. *A* is an iron top, which rests upon the shoulders of four upright steel pillars, which are firmly bolted to the upper surfaced rim of the bottom. Centrally, the top bears a perforated boss for the shaft *S*, and laterally, two smaller bosses with hard-rubber bushings through which pass the vertically adjustible hangers or leads *H*, *H*, also covered with hard rubber, by means of which current is led to the even number of V-shaped steel leaves suspended vertically from the circumference of the conical disk of fibre *C*, which is perforated centrally for the free passage of the shaft *S*. The mechanism for lifting the mercury from the well and projecting it in a continuous stream against the oppositely hanging leaves or electrodes, which are of unlike polarity, consists of the shaft *S*, bearing at its lower part the Archimedean screw *P* with the hollow hub *O* and the two discharge pipes *Q*, *Q*. The discharging orifices of these pipes are tipped with lava, which is held in place by long, fibre screw collars. In the well of the base a number of radial vertical leaves, which just clear the revolving tube of the Archimedean screw, are placed in order to prevent rotation of the mercury when the screw is revolved. In order to render the break extremely quick the air-blast created by two trumped shaped pipes *T*, *T*, attached by a removable collar to a shoulder on the hub, is directed just posteriorly to the jets of mercury. As a container, a glass, an iron, or a fibre cylinder with gaskets at the top and bottom and provided with mica covered apertures is used.

The action of the apparatus is as follows: The heavy rimmed pulley, or sprocket wheel, on the pump shaft being attached by a belt, by a chain, or directly to the shaft of a suitably located electric motor, or to another source of power, if the shaft is rotated at a sufficient speed a continuous jet of mercury issues from each lava tipped delivery pipe. Hence, if oppositely located leaves are connected to the hangers *H*, *H*, of unlike polarity, while the jets are impinging upon such leaves, the current finds a ready path along the mercury. As the streams of mercury separate from the straight, vertical, posterior edges of the leaves the circuit is broken and any more or less conductive incandescent mercury vapor which might prolong the arc is dissipated both by the blast from the blowers and by the air currents generated within the apparatus. Further, it appears in practice that owing to the centrifugal force, and probably to a sufficient lack of cohesion of the mercury streams issuing from the jets, just as the posterior edges of the leaves are reached by the streams, the latter seem to glide off with great suddenness and immediately break into innumerable small blogules, a circumstance that seems further still to favor the quickness of the break, and to diminish the liability to arcing. As the anterior lower corners of the leaves are cut off, elevating or lowering the hangers, furnishes a ready means of controlling the duration of the make without a variation of the period. Further, the period can be varied within considerable limits by merely varying the speed of rotation of the shaft *S*, or the number of leaves can be varied after removing the nuts which keep the top in place upon the pillars and lifting the pump and coned fibre disk out of the containing cylinder.

With this interrupter and an adjustible condenser many varieties of discharge can be obtained from the secondary terminals of an induction coil, and one of the varieties appears practically similar to that produced by the Wehnelt electrolytic break, but is far steadier and subject to no sudden stoppages. As with the latter interrupter the coil should be most carefully made and the layers of the primary very carefully insulated from each other by some high-grade insulator such as micanite, as otherwise the coil will invariably break down.

When a Röntgen ray tube is connected across the coil with properly adjusted air-gaps in series with the tube circuit, if the shaft of the interrupter is rotated at from 1000 to 2000 r. p. m., a fluorescent screen placed in the path of the rays from the tube, fluorescesses with such perfect steadiness that fluoroscopic examinations become a pleasure instead of a fatiguing and more or less uncertain procedure. As an interrupter for actuating high-frequency coils of the Tesla or Kinraide types upon the continuous 115-volt current, the apparatus is exceedingly satisfactory and will also allow comparatively heavy currents to be employed.

If a suitable synchronous motor is employed to rotate the jets at a uniform rate of speed the apparatus may be employed to interrupt every similarly directed half-wave of an alternating current at any desired point, and thus to produce effects when actuating an induction coil that are practically similar to those produced by using the continuous current. Storage batteries also may readily be charged from an alternating current with the interrupter when it is actuated in the above manner with a suitable synchronous motor.

For actuating small step-down transformers such as are used by physicians for energizing their electro-cauteries where only the 110-volt continuous current is available the apparatus with a condenser of suitable capacity is highly efficient.

Before concluding this description, I shall call attention to one more very excellent feature of an interrupter of this nature, namely, the automatic manner in which it prevents the occurrence of an undue rise of current through the primary when the motive power fails or the belt breaks. If such an event happens while the apparatus is in full action the streams of mercury diminish with great rapidity as the revolving shaft quickly comes to a standstill, so that the resistance across the interrupter almost immediately becomes infinite. Similarly, the interrupter may be started with the current fully turned on and as its speed increases the resistance across it gradually falls from infinity practically to zero.

The Zossen Polyphase Railway Installation for Experimental Trials with Speeds Up to 125 Miles an Hour—III.

By Walter Reichel.

(Chief Engineer Siemens & Halske Company.)

RESISTANCE COILS AND RHEOSTAT CONTROLLER.

IN order to bring the car motor up to full speed soon after starting, resistance is introduced into the secondary circuit which is gradually cutout until the secondary circuit is short circuited. The motor furnishes 750 horse-power at starting, and only 250 horse-power when running at full speed, a difference of 500 horse-power.

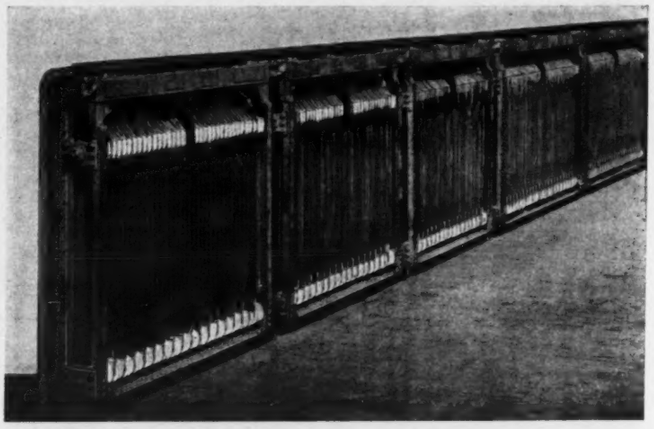


FIG. 16.—CONTROLLER RESISTANCE BOXES.

The coils must be so cut out that no serious sparking is produced. For this reason 29 steps have been selected, four primarily to cut in the motor and the other 25 for the gradual variation of the speed of

the motor. Each step therefore cuts out 20 horse-power, which is permissible in the light of past experience.

It is essential, in order to reduce the length of the connecting wires, to locate the coils and the controller as near to each other as possible, and the coils must be so constructed that the cooling areas are reasonably large and the weight kept down. The room beneath the car floor is well taken up by transformers and switches, although the length of this space is 22 meters (72.16 ft.), and it was necessary to locate the coils within the interior of the car, along the sides of the car body. For each motor and each phase a small and a large box were built, there thus being for each motor three large and three small boxes. The latter contain the four starting coils and the larger boxes the other 25 coils. The small boxes are 1140 mm. (3.74 ft.) and the large boxes 1560 mm. (5.12 ft.) in length. The height of the boxes is 1220 mm. (4 ft.) and the width 150 mm. (5.8 inches). The boxes are constructed of angle iron, and are bolted to the top and bottom girders of the car body. They are covered by sheet iron plates which are built shutter-like so as to serve as ventilators. From the top emerge the leads connecting the various boxes, while the leads to the controller emerge from the bottom. Fig. 16 illustrates a number of coils. The latter are constructed of ribbons of "Kruppine" 45 by 2 mm. (1.75 by .078 inch) in cross section supported on porcelain knobs. The lower knobs are not firmly attached, so that when the ribbons are heated they may extend along their length. The protecting plates and each individual box may be removed from the car with ease.

For each phase of each motor there has been provided a controller cylinder, three for each motor and six on each side of the car. The cylinders also lie in the direction of length of the car and are located directly beneath the large boxes, as shown in Fig. 17. The bronze contact pieces are removable, and the contact springs are mounted on two parallel steel tubes, which are supported by cast steel hangers. So as to avoid the necessity of 25 regulating contacts for each phase, the well-known a, b, c connection has been adopted, in which the coils are cut out successively first in phase 1, then phase 2 and then phase 3.

The controllers are so arranged that on the first contact the four motors are not all cut in together, but one after the other, so that the entire load is not thrown on the station suddenly and a saving of resistance material is effected. The controller cylinders are operated by means of a steel shaft, which runs under the floor from end to end of the car, and which is connected to the four controller shafts by four heavy chains having a strength of 2500 kg. (5500 lbs.), and four chain wheels. There are two ratchet wheels on the shaft for the setting of the contacts, and the shaft is operated from each platform by a set of bevel gears.

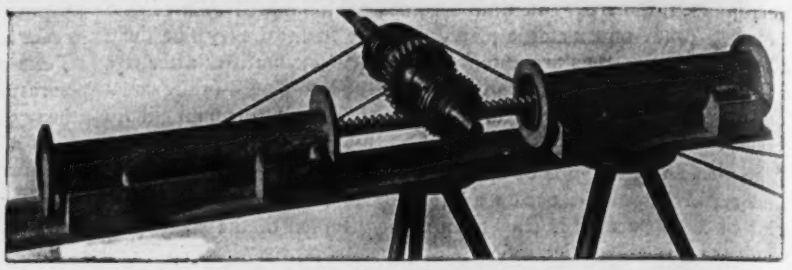


FIG 18.—COMPRESSED AIR CYLINDERS AND REAR FOR OPERATING CONTROLLER.

In order not to tax the strength of the motorman too much, there is situated at the center of the car, at right angles to its greatest dimension, a compressed air device. This consists of two air cylinders working in opposite directions, one having a greater diameter than the other. The smaller one is always under pressure while the larger one is only connected with the air tank when the car is started. As shown in Fig. 18, the pistons of the cylinders are connected by a rack which meshes into a pinion mounted on the main shaft. When the device is set in operation, the larger cylinder works against the smaller one and assists the operator in the control. When the device is cut out, the air escapes from the larger cylinder and the smaller one works alone and automatically brings the controller back to the zero position. The power exerted by the larger cylinder can be regulated, and is so chosen that the operator can stop on any desired contact. In this way the starting of the motor and the regulation of the speed are entirely under his control.

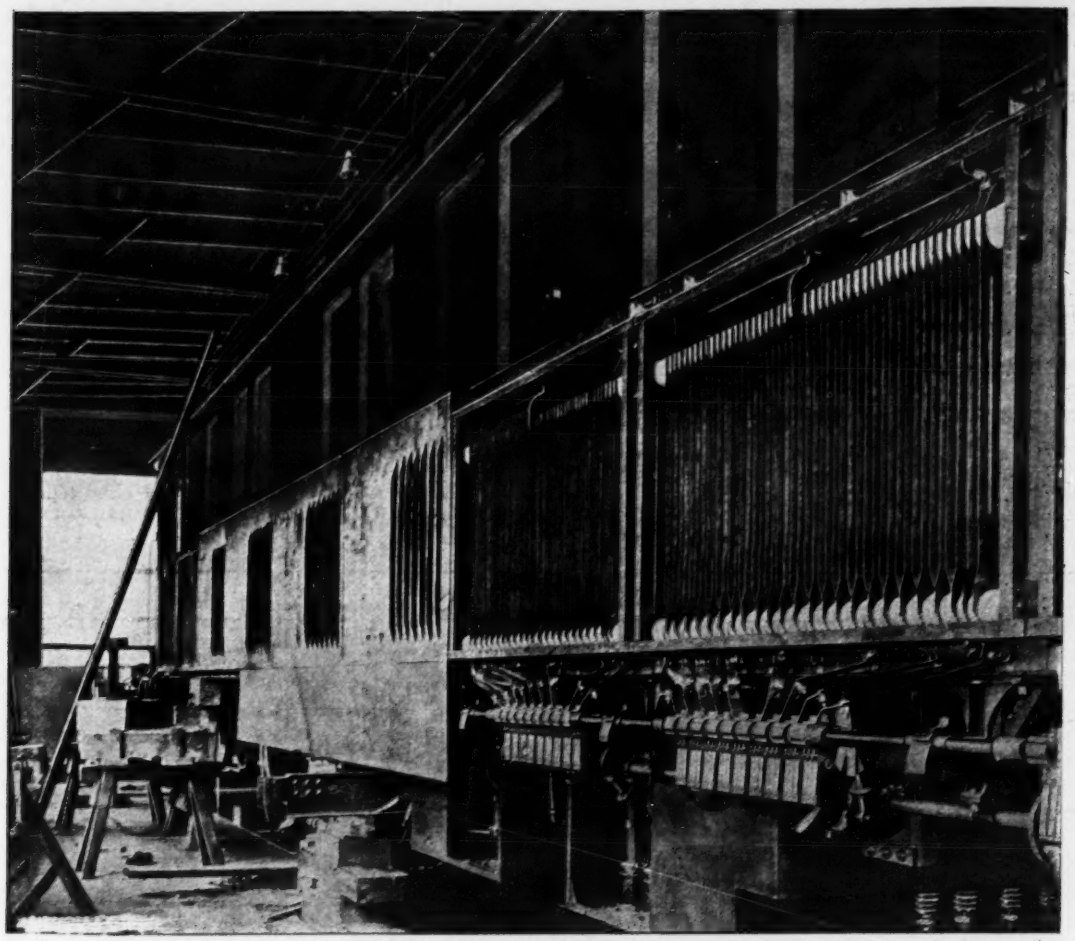


FIG. 17.—RHEOSTATS AND RHEOSTAT CONTROLLERS.

FIG. 21.—MOUNTED MOTOR FUSE.

MEAN PRESSURE SWITCHES AND FUSES.

Each motor is supplied with current from transformers after it has passed through three mean pressure safety fuses (one for each phase) and a mean pressure switch. This is thought advisable for the reason

that the sparking depends upon the amount of current, which is thus cut into four parts, and because any motor which has become inoperative can be cut out of circuit by its own switch. The mean pressure switch is built according to a patent which describes means for drawing the arc in a narrow insulating tube, the arc being extinguished by the aid of a cooling ring of metal. In each phase there is a double break 140 mm. (5.4 inches); there are in all, therefore, six contacts, which are set in a circle. As the switch is operated from the platform by means of compressed air, a starting cylinder is necessary, which is situated in the center of the above mentioned circle (Fig. 19). There is one main contact piece which establishes the current and an auxiliary contact for drawing the arc. The latter only breaks after the main contact has been partly opened. Part of the contacts are stationary, and others movable on what might be called a bridge, which is raised or lowered by the piston of the cylinder. The connection between bridge and piston is, however, not a rigid one, but when the contact is closed the bridge is raised by the piston and is held in that position by a snatch hook. In opening the circuit, the piston first returns alone and only releases the snatch-hook at the end of its travel. This is for the purpose of preventing a slow break of the contacts in case the piston is released slowly by insufficient air pressure.

By this method the contacts are suddenly opened after the piston has nearly returned to its position. The several contacts, cooling

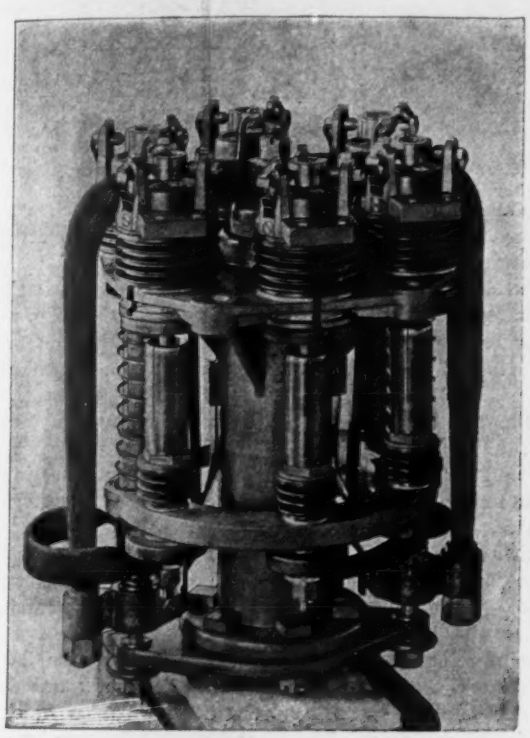


FIG. 19.—MOTOR SWITCH.

rings and extinguishing tube are made of heavy material and can be easily removed. As in the case of the switches for the motors, those for the transformers are built for delta and star connections. For each transformer one switch serves for the star connection, and the other for the delta connection. Each unit of the electrical equipment will thus have four mean pressure switches, which are all placed in a strong box supported beneath the car floor, as shown in Fig. 20. The contacts are insulated from each other and from the frame by hard rubber rings, and are calculated for a pressure of 6000 volts.

The various switches are connected together by heavy, round copper bars, wound with tape, and the leads to the transformers and motors consist of insulated flexible copper cables. The binding posts are placed on porcelain insulators on the outside of the box and can be opened from the outside. The heavy rubber tubes which convey the air from the iron pipes to the switches can also be detached from the outside. The box can, therefore, be taken from the car as a unit after the electrical and air connections have been detached.

The box is built of sheet and angle iron and on the latter all the switches are suspended, being, of course, insulated therefrom. The box also contains the 550-ampere motor fuses, which are accessible through small openings at the side, as shown in Fig. 20. They are the well-known enclosed fuses, in which a number of strips are fused within narrow tubes. The high-tension vapors which are formed extinguish the arcs through the explosive effects which are produced. The fuses are supported vertically, as shown in Fig. 21, and they are taken out in a direction parallel to their longest axis. The fixed contact pieces are mounted on hard rubber posts and the two removable contacts are connected by a heavy glass tube, in which the ignition tubes are located. The vapors which are produced by the melting of the zinc strips escape through sieve-like openings in the box into pipes which lead into the atmosphere. There is furthermore in this box a small current transformer, used for measuring purposes in connection with an ammeter.

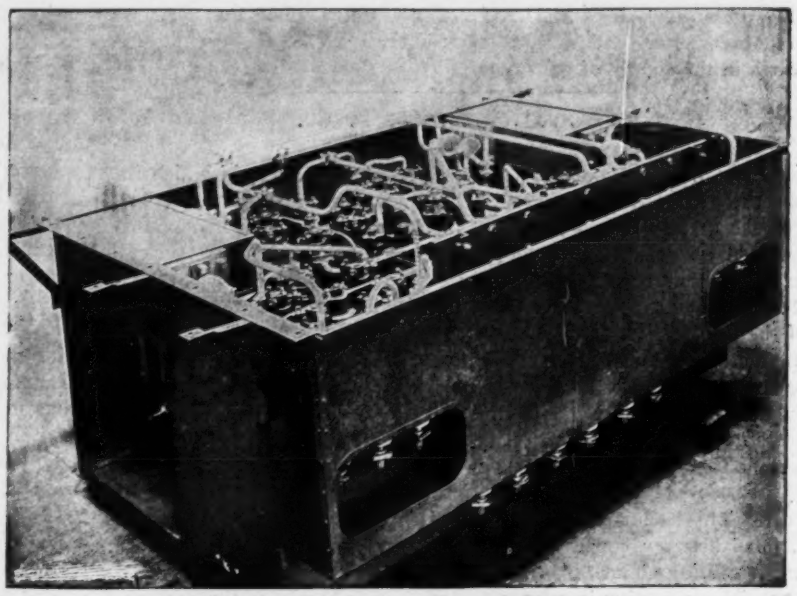


FIG. 20.—MEAN-PRESSURE APPARATUS.

Disintegration of Wood Fibre by Alternating Currents.

A recent proposal, emanating from M. Berget, of Paris, relates to the use of alternating currents for the purpose of inducing fermentation in the agglutinants of wood fibre, thereby freeing the latter and preparing it for the manufacture of paper pulp. The materials, of which nettle stems are mentioned as a suitable example, are crushed and permitted to disintegrate in lime-water for a number of days. After draining they are stacked upon a horizontal wire cloth electrode to a height not exceeding one meter, covered by another electrode of like form and material and subjected during some hours to an alternating current of volume sufficient to maintain the temperature of the stack at 50 to 55 degs. C. Five to six amperes are required for each 100 kilos of material treated, the potential difference between the electrodes being about 40 volts. Under these conditions it is said that fermentation proceeds rapidly and continues for some days after the interruption of the current, the mass being thus prepared for the usual operations of lixiviation, bleaching, etc.

After the many assertions which have been made heretofore regarding the sterilizing power of low-potential alternating currents, it is somewhat disconcerting to find the very same means proposed for the purpose of initiating and promoting fermentation, as in the foregoing method, and in certain others, relating to the manufacture of beer, which have preceded it. The probable explanation is that under these circumstances the current itself has no proper germicidal action, but merely a secondary effect which depends upon the nature of the electrodes, upon the character of the decomposition products liberated, and upon the rise in temperature due to its passage. If so, it is evident that the growth of bacteria may be either favored or checked, or that their vitality may be destroyed, according to their specific characteristics and the conditions of the treatment. For instance, it is likely that the aerobic and anaerobic bacteria would react distinctively to the electrolytic products, and that in the case of the direct current the polarity, with its accompanying oxidizing or reducing conditions, would control the result; in fact, the entire question passes into the proper domain of the biologist.

Submarine Cables and Gutta Percha.

Botanists in France are now engaged upon the problem of acclimatizing the *Isonandra gutta*, the tree which produces gutta-percha. It seems that no other product known at present replaces the gutta-percha found in the forests of the Malay Peninsula and in certain districts in Malacca. Inferior qualities have not the requisite durability for submarine cables. The plantations in the above-mentioned districts have been so ruinously exploited by the natives that it is feared there will be a shortage in the course of 15 years, unless means are taken to protect the forests or to propagate the plants elsewhere.

The following figures will give some idea of the rapid increase in the export of the gum: In 1845, Europe imported only 9000 kilograms (19,841 lbs.) of gutta-percha; in 1857, when the Singapore supply was exhausted, the Malay Archipelago exported more than 240,000 kilograms (529,104 lbs.); in 1879, Sumatran exportations exceeded 135,000 kilograms (299,621 lbs.), and Borneo exported 1,300,000 kilograms (2,863,900 lbs.). In order to attain these figures, it is estimated that the natives must have sacrificed more than 5,000,000 trees.

Expeditions sent out by France, England, and Holland to discover the botanical origin of the precious gum, and to increase its production, have reached the same conclusion. As it is almost impossible to find a full-grown gutta-percha-producing tree, the situation will be extremely grave if urgent measures are not taken. The British Government has posted placards for the protection of the trees, with no effect. Holland has planted trees, but in insufficient number and of inferior species. Productive species have, however, been found in the Malay forests extending between the rivers of Pahang, Patani and Perat. They have been transplanted into Reunion and Madagascar, and if they thrive there will be less danger of a dearth in the supply of gum required for submarine cables.

Growth of Export Trade.

The growth in exports during the period since 1896, in which the increase in exports has been more than 50 per cent compared with an increase of less than 15 per cent in imports, has, as is well known, included all great classes of products and manufactures. Agricultural products now form 63.7 per cent of the total exports, and in 1896 they formed 63.9 per cent. Manufactures now form 29 per cent of the total exports, and in 1896 they formed 28.3 per cent. During the last year, however, the exports of manufactures have not kept pace with those of other industries. In the eight months ending with July, 1901, the latest month in which the details are accessible, exports of manufactures fell $32,000,000 below those of the corresponding months of last year, while exports of agricultural products were $57,000,000 greater than those of the corresponding months of last year. This reduction in exports of manufactures is about equally divided between copper and iron and steel, the reduction in copper exports being about $16,000,000 and in iron and steel about $16,000,000. The reduction in copper exports is chiefly due to the decreased demand for copper in other parts of the world for use in electrical and other industries. In exports of iron and steel the reduction is apparently due somewhat to the partial suspension of manufacturing activities in certain lines in the past few weeks, partially to the reduced demand abroad, partially to the reduction in prices of the articles exported, and in large part to the fact that the exports of Hawaii and Porto Rico which were included in last year's statistics, are not included in the figures for the present year, the total exports of iron and steel of those two islands in the fiscal year 1900 having been about $7,000,000.

The Telephone Outlook in Siam.

Mr. Hamilton King, the United States Consul General, writes as follows from Bangkok, Siam, under date of Aug. 1: Bangkok enjoys the advantages of an electric light plant and of an electric tram line 6 miles long, and is now laying a second line of equal length. These are all private enterprises. The service of the two plants already in operation is fairly good, and, together with the introduction of the new tram line, they mark a decided advance in the development of the city.

The telephone system of Bangkok is decidedly bad. It is owned by the Government, and forms part of the postal telegraph department. There are some 200 instruments of the Keiser-Schmidt, Berlin, make in the city at present, and to any one who has ever attempted to use one of these, it is evident that even this limited number stands as a monument to the patience and good nature of the citizens. Better results are produced every day by the American boy with his tow string and the resonant bottom of a tin can.

Yet this is a city of magnificent distances, and, taking into consideration the manner in which the palace and its surrounding public buildings are separated from the legations and consulates, the distance of the walled city from the residences of most of the foreigners, of the large foreign firms one from the other, of the old palace group from the new palace in its beautiful park, and the entire division of the old city from the new by the river, which is crossed by no bridges, few cities are better fitted to appreciate a first-class telephone system. The Siamese are a people who know a good thing when they see it, and they, together with the long-suffering members of the foreign community, would generously patronize a good telephone system, were it at once established. There should be at least 1000 instruments in use in the city, in place of 200, and this number without question would be largely increased as the fact was borne in upon the public that a telephone was invented to save time and for convenience.

There would seem to be an opening for the introduction of an improved system in Bangkok, and with the present condition of affairs, a few first-class instruments in some of the public buildings might soon work a change in the entire city.

The Influence of Polyphase Apparatus on the Design of Railway Power Stations—II.

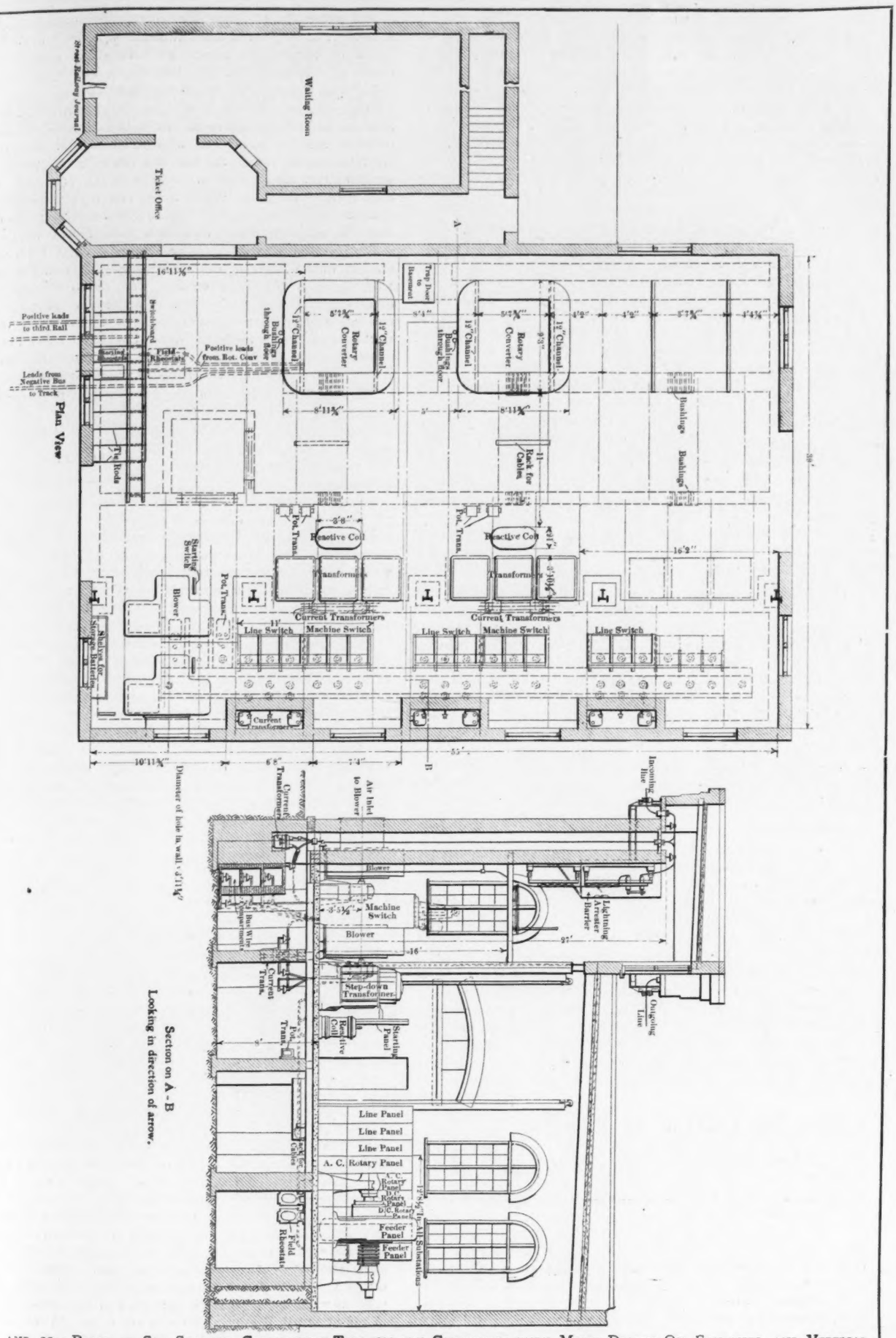
BY J. E. WOODBRIDGE.

LARGE POWERS AND HIGH VOLTAGES.

ON systems of extra high voltage, 20,000 volts or over, or of comparatively great contemplated generating capacity, 5000 kilowatts or over, or both, the oil switches are usually made of a type and size that precludes hand operation and necessitates some auxiliary power, preferably electric motors. The abolition of the mechanical connection between the switchboard and the oil switches allows the latter to be placed at any convenient points in the station, regardless of the location of the switchboard panels proper. This change has a great influence on the best arrangement of apparatus in the station.

Figs. 10 and 11 show the arrangement of the apparatus in a sub-station containing two 500-kw six-phase converters with air-blast transformers supplied at a pressure of 26,000 volts from a generating station which will eventually be so large as to necessitate the type of switch here shown in order that any one of the switches may break any possible short circuits with full station generating capacity connected.

In this particular station there are three high-tension lines, two incoming from the generating station via different routes forming a ring system, and one outgoing to another sub-station which is fed from the ring at this point. The oil switches of the type here shown are wired from below, on which account all high-tension leads, bus-bars, etc., are located in the basement below the oil switches, which are mounted on the ground floor. The high-tension leads from the transformers are also brought out from the transformer casings through the openings in the bases, thus keeping practically all high-tension wiring in the basement. What little must be run above the basement to reach the overhead lines is carried up in flues built into the wall. The wiring in the basement is entirely enclosed in the blast chamber. Since all high-tension wiring is thus shut away from any unintentional interference, it may be and is entirely uninsulated, no rubber covering being used whatever on the sub-station high-tension wiring. The life of rubber insulation unprotected by lead is somewhat doubtful at this high voltage, and lead-covered cable is highly objectionable at this voltage for station wiring owing to the possibility of breakdown at any point in case of any extra high potential disturbances. Bare wire, with nothing but air and porcelain insulation is thus a happy solution of the problem. All bus-wires and high-potential leads are in this case supported on ordinary pole line porcelain insulators of what are known as the "Redlands" type, such insulators being, of course, absolutely reliable in such a dry place as a blast chamber. Brick, tile and concrete slab barriers are used between the leads. The lightning arresters are in this station mounted on the face of the wire flues, a light gallery being used to give ready access to them.



FIGS. 10 AND 11.—PLAN OF SUB-STATION CONTAINING TWO 500-KW CONVERTERS WITH MOTOR-DRIVEN OIL SWITCHES, AND VERTICAL SECTION THROUGH THE SAME.

HIGH-TENSION WIRE INLETS AND OUTLETS.

For this high voltage care must be taken with the insulation of the wires passing through the wall of the building. A heavy rubber covering may be used with the ordinary porcelain tubes, but this insulation is limited by the life of the rubber. A clear opening with indoor anchorages is objectionable on account of the wetting of lightning arresters or other parts at times of heavy driving storms A long creepage distance over high-grade insulation is necessary between each wire and the wall of the building where exposed to the weather. This can readily be obtained with a structure like that shown in this sub-station. Here the wire approaching from the pole line is anchored to a porcelain strain insulator of a type with several eave-shaped corrugations both above and below the fastening of the wire. From this strain insulator the wire passes upward into the building through a porcelain bushing with a corrugated top indoors and a petticoated lower portion outdoors where exposed to the weather. With an insulation of this kind no rubber is necessary. This, of course, calls for an extension of the building in the form of an overhang, not unlike a dovecote in appearance. In this particular sub-station this overhang is supported by steel work in the form of a cantilever.

This sub-station will be combined with a passenger station of the third-rail electric line which it will feed, the ticket office being located within view and easy access of the switchboard, so that one man may tend to both. Attendant's quarters will probably be combined with passenger station and separated from sub-station by fire wall.

The Inductor Alternator—II.

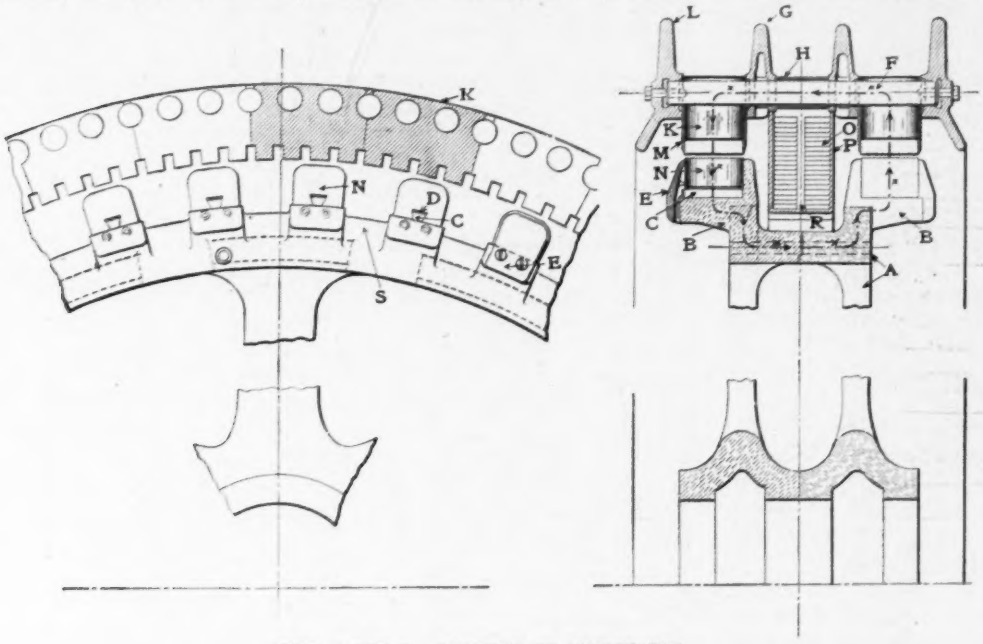
BY EDWARD HEITMANN.

MECHANICAL CONSTRUCTION.

THE following will contain a description of the principal mechanical features of a well designed inductor alternator, and at the same time discuss some of the electrical features.

Fig. 2 shows the section of a S. K. C.* alternator. The inductor consists of a cast steel spider and rim *A*, made either in two parts for small generators or in four parts for large machines, these parts being securely and firmly bolted together to form a revolving element of rigid and safe construction. The hub is usually clamped to the shaft and held in place by either one or two keys.

On the face of the rim the lugs *B* are cast, as shown in the figure, for the purpose of holding the laminations *N*, which form the pole pieces. The method of securing these laminations to the lugs can readily be seen. *C* is a key fastened to the lug by a number of screws. The laminations are slipped over the key *C*, the slot *D* (Fig. 2) fitting snugly onto the same, and the whole held in place by the retainer *E* (Figs. 2 and 3).



FIGS. 2 AND 3.—SECTIONS OF ALTERNATOR.

The punchings *N* are always shaped so as to cause a distribution of flux across the pole face, such that the induced e. m. f. wave will have the closest possible approximation to a sine curve. This is effected by varying the air-gap gradually from a minimum at the center to a maximum at the outer edges, according to data determined theoretically and verified experimentally.

The entire construction is of a most rigid character; at the same time the fibre strains are taken low so the inductor will stand an increase of speed of 50 per cent with perfect safety. This robust construction, together with the fact that the revolving part contains no wire or other active material liable to injury, permits of the use of high peripheral speeds, which is a distinct advantage in designing electrical machinery in many instances. Surface speeds as high as 10,000 ft. per minute have been used in large high-speed alternators.

The metal at *S* between the pole pieces is entirely cut away. The method of construction can more readily be seen and understood from some of the following cuts of generators. This results in greatly increasing the reluctance of the leakage path, and therefore decreasing the leakage field in proportion. The effect of this field is therefore hardly appreciable, the flux itself never amounting to more than 5 per cent of the main flux. The construction of the armature is in every way as rigid and substantial as that of the inductor.

The steel bars *F* are called magnet bars, and serve the purpose of carrying the magnetic flux. The inside rings *G* are first placed over them and held apart by the pipe washer *H*. The armature punchings *K* are then slipped over the bars and finally held in place by the outside rings *L*. Heavy steel stiffeners *M* are placed at each end of the laminated iron.

It may be noted here that with the exception of the rings *G* and *L*, all the metal is active, that is, is utilized for carrying the flux. This type of alternator therefore requires no additional cast iron or steel structure to carry the armature iron, so with the reduction in the weight of the laminations made possible by the use of high densities, as before explained, the weight of an inductor alternator will not be greatly in excess over the weight of a revolving field type having the same characteristics.

After assembling in the manner described, the coils which make up the armature windings are placed in the slots. The coils are machine wound. They are carefully and thoroughly treated with insulating compounds, wrapped with a special insulating material and baked before they are placed in the machine.

The winding is of the style generally known as a concentrated winding. Owing to the specially shaped pole pieces it becomes unnecessary to distribute the coils in this type of alternator to obtain a sine wave of e. m. f. and all the advantages of a concentrated winding can be fully realized. It permits of the maximum insulation with minimum expenditure of room ensuring perfectly reliable insulation for all voltages. When it is known that for some potentials about 40 per cent of the slot is taken up with insulation, it will readily be seen what an important item this is in the economical design of alternators. It permits of readily removing a coil for repairs without disturbing a large number of other coils. In most machines of this type under discussion the coils can be dropped down between the poles pieces and then drawn out sideways, thus making it possible to remove a coil without disturbing any other part of the machine. Fig. 4 illustrates the method of removing coils very well. Sliding armatures, therefore, are unnecessary.

The claim is often made that owing to the concentrated winding the self-induction of the armature circuit must be extremely high and that, therefore, the regulation of this type of alternator must be very poor on inductive loads. A consideration of the following facts will show that this claim does not hold good. When a current flows through the armature conductors, it sets up a field surrounding these conductors, varying with the current, and thus inducing an e. m. f. in the armature winding known as the e. m. f. of self-induction, or counter e. m. f. The field is directly proportional to the ampere-turns in the slot and inversely proportional to the reluctance of the

*S. K. C. are the initials of the individual inventors of this type of apparatus—Messrs. William Stanley, John F. Kelly and C. C. Chesney.

flux path. The counter e. m. f. is directly proportional to this field and the number of turns. Hence, if the reluctance and current remain constant, the counter e. m. f. will vary as the square of the turns per slot. For this reason it might at first appear that the above contention were true, and that distributing the windings in two or more slots per pole per phase, the self-induction must be greatly descreased.

As the number of slots is increased, the reluctance cannot be kept the same for a reason that will at once become apparent. For the

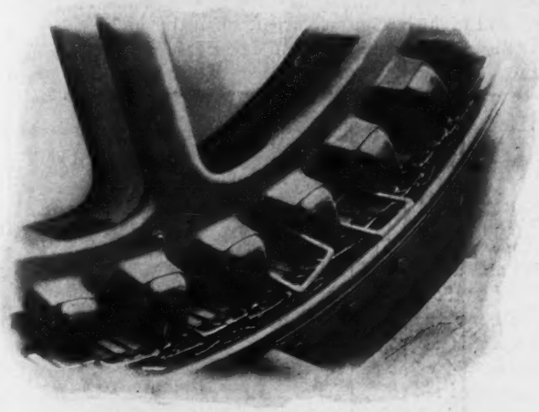


FIG. 4.—REMOVABLE COILS.

sake of simplicity consider that the field set up by the armature ampere turns has two paths, one across the slot and the other around it. The reluctance of the path across the slot is inversely proportional to the depth and directly proportional to the width of the slot; in other words, this leakage field is much greater for a narrow and deep slot than for a wide and shallow one. For reasons given before, the slots in an inductor alternator can be made wide and shallow, the ratio of depth to width rarely exceeding 1.5, while with a distributed winding the slots must be made narrow and deep to accommodate the extra insulation required and to keep the machine from becoming excessive in size. In this type of machine the ratio of depth to width is usually three or more. The leakage around the slot is inversely proportional to the reluctance of this path. The fact that the teeth are worked at such high densities in inductor alternators makes the reluctance of this path very great. All this goes to show that the field which induces the counter e. m. f. of self-induction is very little, if any, greater in an inductor alternator than in a revolving field alternator, as usually designed. If the ends of the coils lie in close proximity to the iron, as they usually do, there will be

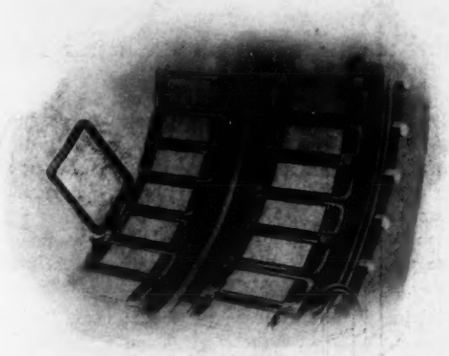


FIG. 5.—SPLIT COILS.

considerable self-induction in these parts. This can be reduced by splitting the coils, as shown in Fig. 5, which illustrates a two-coil per slot winding, which is now used entirely for voltages up to 6000.

The slight reduction of the coefficient of self-induction due to distributing the winding is made manifest by the following: The coefficient of a machine having slots 1½ inches wide by 1 5-16 inches deep, and 60 conductors per slot was measured and found to be .085 henries. New armature punchings were made and the 60 conductors distributed in three slots, each slot ½ inch by 1 23-32 inches. The coefficient was then found to be .076 henries, a reduction of about 10 per cent.

Another important factor which causes a drop in voltage is armature reaction. To illustrate more easily, the effect of this reaction, assume that there is no CR drop in the armature, and that the current is entirely wattless, that is, lagging 90 degs. behind the e. m. f. The counter e. m. f. will then be in direct opposition to the induced e. m. f., and the armature ampere turns directly opposed to the field ampere turns. Let A and B (Fig. 6) be two saturation curves. In A the machine is worked above the knee of the saturation curve and in B at the knee of the curve. The induced e. m. f. is 2500 volts in both cases, and the armature ampere turns are 2000. The field ampere turns are 9300. Since with a wattless load the armature ampere turns are directly opposed to the field ampere turns, the resultant ampere turns will be $9300 - 2000 = 7300$. These are equivalent to 2240 volts for A and 2140 volts for B; that is, the drop in voltage due to armature reaction is greater by 100 volts for the machine worked at the lower point. Assuming the counter e. m. f. to be 100 volts for both machines, the total drop will be 360 volts or 14.4 per cent for A and 460 volts or 18.4 per cent for B; that is, working generators well

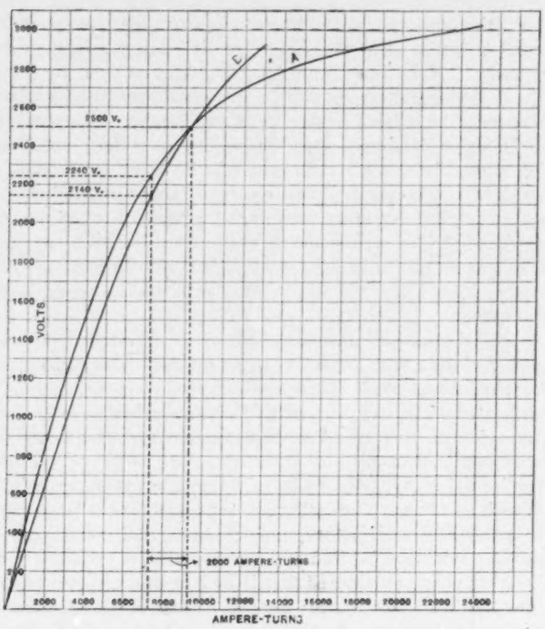


FIG. 6.—SATURATION CURVES.

above the knee of the saturation curve effects a marked improvement in their regulation, and especially for inductive loads.

For reasons given before, the armature teeth can be saturated, the core worked at very high densities, and owing to the very short magnetic circuit all other parts of this machine can be worked at high densities without unduly increasing the energy required for excitation. The inductor alternator, therefore, not only regulates well on non-inductive loads, but also regulates remarkably well on inductive loads.

The field coil, shown at O (Fig. 3), is made up of a wire or strip winding enclosed on three sides by a heavy brass bobbin P. A ventilating space R is left in the middle, separating the winding into two parts. Air is forced through this space, as well as round the sides of the bobbin by the poles of the revolving inductor. The winding is thoroughly insulated from the brass bobbin, while the latter, due to its secondary action, when the field circuit is broken, insures the coil from all danger of breaking down when discharged.

Having but a single coil amply designed, thoroughly ventilated and stationary, the risk of this member becoming disabled is very slight indeed. Other more general features of construction will be given in a concluding article.

Illinois State Electric Association.

The second annual meeting of the Illinois State Electric Association was held at Rock Island, Ill., Sept. 24 and 25, 1901. The association was welcomed on behalf of the Mayor by Mr. Davis, and the Hon. J. N. C. Stumway, of Taylorville, responded on the part of the association. Secretary Chubbuck reported that the association, which originally started with 22 members, had at the first annual meeting doubled that number, and that at present 85 members are enrolled.

The feature of the meeting was a long discussion on the utilization for heating purposes of the exhaust heat from electric light plants, which followed the report of a committee on this subject. The report of the committee stated that electric power stations should be able to obtain an important income from the sale of their exhaust steam. The steam mains should be of wrought iron and so proportioned that the back pressure on the engine need not exceed 2 to 5 lbs. A 6-inch pipe is required to convey about 200 horse-power of steam a mile under 5 lbs. pressure, and this will heat 2,000,000 cubic feet of space in average buildings. An 8-inch pipe will distribute over the same distance 475 horse-power of steam, which will heat 4,750,000 cubic feet of space, and a 12-inch pipe will convey 1140 horse-power of steam and heat 11,400,000 cubic feet of space.

The best covering for pipes consists of a white pine casing made of staves thoroughly kiln dried and coated with asphaltum, the lengths being joined by mortised tenons. The loss by condensation with this covering runs from 1½ to 6 per cent per mile of pipe, the percentage, of course, being smallest in the larger sizes of pipe and greatest in the warmer months when the pipes are delivering less than their rated capacity. Expansion should be taken care of by a packingless device. One hundred horse-power of steam will heat 1,000,000 cubic feet of space in the coldest weather and produce an income of from $3,000 to $4,000 per heating season, depending upon the price of coal. Assuming this to be the case, the gain will be much more than may be obtained from the most efficient engine. It was stated that compounding an engine increases its thermal efficiency to 13 per cent, and a condenser added raises this to 18 per cent, but even in the latter case, 82 per cent of heat units pass off in condensing water. When a condensing apparatus is in use it may be discontinued during the heating season.

The approved plan in the construction of steam mains seems to be a single line of pipe without returns, for by the use of economizing coils the heat from condensation and radiators is utilized in the buildings heated. The small amount of water condensed in the mains themselves should be trapped at some convenient point, and thus separated from the steam.

In the discussion, Mr. Shumway said that a great many buildings require much less steam than others to heat, and that it is impossible to make a flat rate satisfactory to both seller and consumer. Mr. Glidden, who said that he had had seven years' experience in running a heating plant, considered that if he had to do it over again he would use the hot-water system instead of distributing the exhaust steam direct for heating. At the same time he had been very successful in using steam direct. Mr .Shumway said that his plant runs during the day in the winter to furnish heat to its customers. The coal bill increased, but the receipts from the heating more than paid the entire coal bill for the plant. As to depreciation, he recently saw some steam mains taken up at Springfield that had been in the ground 11 years, and he had tried very hard to buy the pipe because he regarded it just as good as the day it was laid underground. Referring to the construction of the covering, he said it is of a hard indestructible character. It is lined with tin to reflect the heat back to the mains, is soaked with asphaltum or covered with tar and paper, pipe tiles being laid along the mains to drain off the surface water. He believed that his great grandchildren will find that the distributing mains he laid are just about as good as to-day. He has known of pipes laid for 30 years that are in excellent condition with the exception that there is some decay at the mortise and tenons. In his opinion 2 per cent would be amply sufficient to set aside for depreciation.

Another report on the subject of exhaust steam heating was presented by Mr. Hayes. He said that with modern steam pressures of 125 to 150 lbs. the low pressure necessary for exhaust steam heating if of small account in the economy of operation. As to the casing for the pipes, the mortise and tenon wooden conduits above referred to, lined with tin in order to prevent too rapid deterioration, are absolutely essential to prevent corrosion from rust or electrolysis. In some cases wooden troughs or boxes have been substituted for these with disastrous results.

The following list of cities was given, having more than one mile of steam heating mains: Scranton, Pa., 15 miles; Overbrook, Pa., 33,169 ft.; Wilkinsburg, Pa., 26,000 ft.; Cedar Rapids, Ia., 8300 ft.; Topeka, Kan., 7200 ft.; Lockport, N. Y., 2½ miles; Pottsville, Pa., 7700 ft.; Grand Rapids, Mich., 6000 ft.; Champaign, Ill., 5280 ft.; Danville, Ill., 1½ miles; Atlanta, Ga., 5 miles; Allentown, Pa., 37,300 ft.; Seattle, Wash., 6500 ft.; Springfield, Ill., 20,518 ft.

At Erie, Pa., the station is situated nearly 3500 ft. from the first customer. In conclusion, it was stated that a central station that has day and night business sufficient to justify undertaking the selling of exhaust steam, can depend upon favorable returns upon the investment, and experience has shown that a customer who has once adopted this manner of heating very rarely makes a change.

Mr. Langford said that in his plant a box is used for encasing the pipe, made with plank with two air spaces, which may be described as three boxes, one inside the other, with a half air space between, the boxes being covered with two layers of paper and tiles used underneath the boxes for drainage. In ten years absolutely no deterioration has occurred. In this case there are two pipes in a box, a supply pipe and a return pipe. The system is a hot water one. Water going out at 180 degs. comes back with a temperature of 172 to 175 degs. with no radiators connected. With all radiating connections made there is about 30 degs. drop in the temperature. The rate charged is 12½ cents per square feet of radiator. In zero weather a temperature of 180 to 190 degs. is sufficient, but in this case some live steam is used in heating the water. This was done about five weeks during last winter. The average radiation for a seven to eight-room house is 500 square feet. Certain rules are used to figure the amount of radiation required in any room and the customer is charged on this basis and may put in as much radiating surface as he chooses. There is an air pump at the station and a ¾-inch air pipe. Mr. Shumway recommended that pipes should only be laid in profitable districts and not run long distances away merely to get a few customers. Mr. Langford, whose station employs the hot-water system, said that the radiators can be so regulated by means of a thermostat that the temperature of a room will not vary more than 1½ degs. through extremes of weather.

Danville was selected as the next place of meeting of the association, and the following officers were elected for the ensuing year:

President, S. S. Davis, of Moline; first vice-president, W. F. McCullough, of Beardstown; second vice-president, John W. Glidden, of DeKalb; third vice-president, W. Steinwedell, of Bellville; secretary, H. E. Chubbuck, of Quincy; treasurer, D. Davis, of Litchfield. Executive Committee: W. B. McKinley, of Champaign; R. L. Allen, of Joliet; F. W. Little, of Peoria; J. N. C. Shumway, of Taylorville, and F. J. Baker, of Chicago.

Papers were read at the meeting by Mr. William S. Hine, of the Western Electric Company; Mr. Porter, of the Lea Company, and Mr. Ryan, of the General Electric Company, the title of the latter being "Enclosed Arc Lamps for Street Lighting."

Reporting the Yacht Races by Wireless Telegraph.

A practical test of the wireless system of telegraphy was made in reporting the yacht races off Sandy Hook last week and the week previous, and viewing the results from a commercial standpoint, the system was found wanting in one vital point. It was shown that the problem of securing immunity from interference remains to be solved, at least so far as the systems under test are concerned. When there were no disturbing influences present the several systems appear to have worked satisfactorily, but owing to their interference the net result was far from satisfactory.

The Associated Press chartered the steam yacht "Mindora," and had her fitted out with a complete equipment of Marconi apparatus. The "Mindora" followed the yachts around the course each day and reporters aboard sent frequent bulletins to headquarters, announcing the details of the race. The wireless messages from the "Mindora" were received at a station located in the hotel at Long Beach, L. I., and from there transmitted to the New York office by telegraph. The Marconi Wireless Telegraph Company sent the entire equipment and staff of operators to this country from England expressly to report these races.

The "Mindora's" topmast was removal, and in its place was spliced

a longer spar for the purpose of supporting the antenna or aerial wire. The total height of the mast from the deck was about 106 ft. The wire was not run down the mast, as is usual, but hung from the mast-head and drawn taut so as to form one side of a triangle whose opposite side was the raking mast, the base being the horizontal distance between the mast and wire. It was insulated throughout its entire length, except at the lower end, where it was connected with a cable leading down through a skylight to the instruments in the cabin. Judging from the character of the joint it is evident that resistance loses much of its terror in a system of this nature. It was what is ordinarily called a bell-hanger's joint, being a loose turn of the ends of the wires around each other. The cable leading to the instruments had a stranded conductor and was protected by a waterproof flexible covering.

The instruments were placed on a temporary wooden bench at the foot of the companion way, and included two large spark coils (only one of which was used), a battery of Leyden jars, a condenser and inductance in one large box, an ink recording instrument, and a box containing a Siemens relay and the coherer, besides a bank of incandescent lamps used to reduce the voltage in charging the storage battery from the yacht's dynamo. The entire equipment was English except the lamps, and the enamel rheostat. The continental code was used in sending dispatches, and the operation of the system, when free from interference, seemed to be very satisfactory. The signals received from the land station were recorded very clearly on the tape, and messages were exchanged with great freedom.

More or less annoyance and trouble were experienced, however, through the interference of another system of wireless telegraph; in fact, there were three systems in use. The second was that known as the de Forest system, and was used by the Publishers' Press Association. In order that both systems might be used without interfering with each other, it was agreed that the time be divided between the two, the Associated Press taking five minutes and the Publishers' Press the next five minutes, and so on, alternately. This plan worked all right for a time until the third system appeared on the scene. The third party was very unwelcome, and seems to have had no other purpose in view than to upset the carefully arranged plans of the two press associations. The result was that while the third man was sending out his waves the other two systems were *hors de combat.*

The transmission speed of the Marconi system was about 12 words per minute, and the greatest distance from the land station to the "Mindora" was about 20 nautical miles, as measured on the chart.

On the tug Edna V. Crew, which carried the Publishers' Press outfit, the aerial wire was a distinctive feature. It was a ladder-like structure, four vertical wires being held parallel to one another by cross pieces, and suspended from the mast head. It is claimed that the de Forest system sends out very powerful waves, but its real value in this respect was not demonstrated, owing to the breaking down of the insulation of an important piece of apparatus. In this system a motor of special design is used in place of the induction coil, and it was the motor that failed. An induction coil was substituted for it, and with this foreign element in its make-up the system was used throughout the races. The Publishers' Press had land stations at Sandy Hook and Seabright. It is stated that signals were transmitted over an extreme distance of 22 miles before the failure of the apparatus.

The operation of the Marconi and De Forest systems was witnessed by Lieutenant A. M. Beecher, of the United States Navy, who was detailed for the purpose by Admiral Bradford.

The Marconi interests were in charge of Mr. W. W. Bradfield, from the company's headquarters, the operator on the "Mindora," also from London, being Mr. A. Gray.

The system operated for the Publishers' Press was that of the American Wireless Telegraph Company, the inventor, Mr. de Forest, hailing from Chicago, where most of his experimental work was carried on.

Recent Telephone Circuit Patents.

In the case of grounded circuit lines or metallic circuit party lines equipped with selective signals and, consequently, having permanent grounds, supervisory signal plug circuits of the usual type cannot be used, since they would furnish a path for the current through the supervisory signal without respect to the operation of the telephone switch at the subscriber's station which must necessarily control the supervisory signal. A patent granted Oct. 1 to Frank R. McBerty provides an automatic clearing-out device for such circuits.

Referring to Fig. 1 the supervisory signal is an electromagnetic indicator instead of the usual incandescent lamp. Each electromagnetic indicator is permanently shunted by a non-inductive resistance for the purpose of cutting out the resistance of the magnet windings with

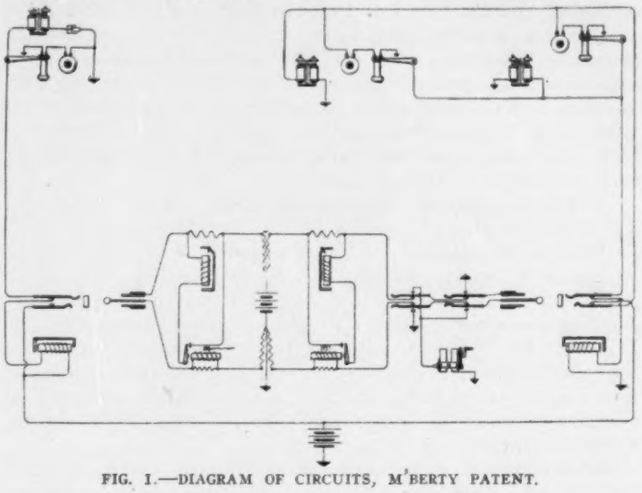


FIG. 1.—DIAGRAM OF CIRCUITS, M'BERTY PATENT.

respect to telephone currents. Each electromagnetic indicator is controlled by a relay in the cord circuit. In the case of the grounded circuit line the relay is operated by a battery, one pole of which is grounded and the other connected normally to the subscriber's line by means of the answering jack and line signal operated by this battery.

When the plug is inserted in the answering jack the path for the current from this battery is diverted from the line and line signal through the controlling relay, which is then excited and closes the contact which brings the supervisory signal in circuit with the common battery, thereby causing the supervisory signal to conceal its target. When the bridge at the telephone station is broken, the current ceases to flow through the relay, which then breaks the circuit of the supervisory signal and allows the latter to display its target. In the case of the metallic circuit line the controlling relay is operated by the common battery, finding itself in the circuit made by

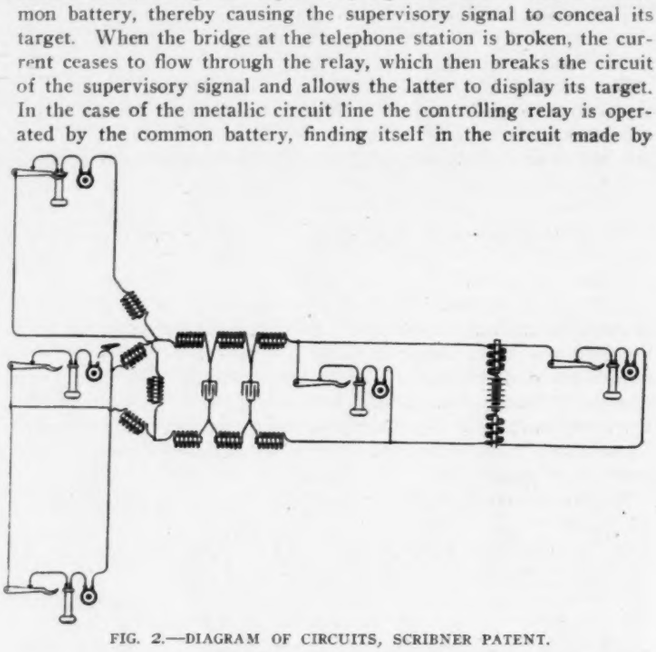


FIG. 2.—DIAGRAM OF CIRCUITS, SCRIBNER PATENT.

the two sides of the split repeating coil, the two branches of the line and the bridge established at the telephone station in use.

As soon as the bridge is removed by the replacing of the receiver on the switch hook, this circuit is broken and the relay is released, thereby breaking the circuit of the supervisory signal and causing its target to be displayed. This arrangement of the relay on the side of the cord circuit attached to the metallic circuit line having selective signals obviously precludes any interference with the operation of the relay by the existence of the permanent grounds on that line.

A patent granted the same date to Charles E. Scribner refers to an

arrangement of telephone circuits enabling several lines and stations to be supplied with energy from a single center without cross-talk between the several lines and without great waste of energy caused by the apparatus introduced in the circuit to prevent the cross-talk. The invention is an improvement to one forming the subject of a patent granted to C. E. Scribner and F. R. McBerty in 1896.

The speaking currents (Fig. 2) are localized in the several circuits joined together to a common source of supply, by means of the insertion of impedance coils of high impedance but low resistance at the junctions between the circuits; bridges are made between the impedance coils on opposite sides of the circuits by means of condensers of high capacity. In the older method resistance coils were used for these bridges, which, while effective in preventing cross-talk, caused a waste of current that is entirely obviated by the use of condensers, equally effective in preventing cross-talk between the various circuits.

An automatic signaling system for telephone exchanges is the subject of a patent granted the same date to James L. McQuarrie. This refers to an elaboration of the present system of automatic ringing in use on "B" boards manufactured by the Western Electric Company, by the addition of an automatic device for connecting a phonograph or other special signal after a given lapse of time to the line of the calling subscriber to inform him, in the event of the called subscriber failing to answer, that his correspondent does not respond to the signal of the exchange. The device is equally applicable to incoming trunk or "B" lines to notify the subscriber operator at the originating exchange of the same fact.

The operation is extremely ingenious, the existing apparatus of the relay switchboard being cleverly utilized to make the ringing and "don't answer" signal entirely automatic. When the plug is inserted in the jack of the called line a path for the ringing current is found by means of the relay armature of the supervisory signal, which is inert by reason of the receiver of the called station being on the hook. The ringing current is automatically applied at intervals, according to present methods until, at the end of a certain time, a step by step movement throws a switch which connects the special signal to the calling line. The calling subscriber being then notified by the special signal that the subscriber he wants does not answer replaces his receiver and so lights up his supervisory signal. The operator then has both lights, that on the called line not having gone out at all, and she promptly disconnects the two plugs and so restores all apparatus to its normal position.

The apparatus, while naturally very complicated, is most ingeniously worked out and is a striking illustration of the automatic character with which the large telephone switchboard has become invetsed since the introduction of the common battery system.

CURRENT NEWS AND NOTES.

THE ST. LOUIS EXPOSITION.—The design of the Electricity Building of the St. Louis World's Fair, to be held in 1903, has been assigned to Messrs. Walker & Kimball, architects, of St. Louis. The dimensions of the building will be 525 by 600 ft. Compared with Electricity Building at the Columbian Exposition in Chicago, the St. Louis building will have 77,000 square feet greater area. The Chicago building was far from filled with electrical apparatus.

THE YACHT RACES were followed with a great deal of interest by electrical people, many of whom, through the courtesy of friends, were enabled to see the "Columbia" win in the fine struggle with the "Shamrock," under ideal conditions of comfort and enjoyment. Mr. W. S. Gould entertained a number of well-known electrical folk on his beautiful yacht "Neaira," from day to day, while the Roeblings, as usual, were generous hosts, Mr. H. L. Shippy extending a lavish hospitality on board the "Nerita." Mr. R. A. C. Smith on the "Catania" made a host of electrical friends at home. Mr. Frank J. Sprague had the pleasure of spending one of the days on board the beautiful "Erin" as a guest of that genuine British sportsman, Sir Thomas Lipton, owner of the "Shamrock."

AUTOMOBILE RACES IN PROVIDENCE.—On Oct. 17 the Rhode Island Automobile Club will hold a race meet, with the sanction of the Automobile Club of America, at Narragansett Park, Providence. There will be three races of five miles for steam, gasoline and electric vehicles. The electric carriages are to be of 12 hors-power or under, and the prize will consist of two cups. The fourth race is for all vehicles over 12 horse-power, the distance being 10 miles, and the fifth race, 10 miles, is a sweepstakes for all winners of other races. The prizes are two cups for the fourth race and one cup for the fifth. Messrs. R. Lincoln Lippitt, F. E. Perkins and H. G. Martin constitute the committee on tours, runs and contests.

WIRELESS TELEGRAPHY ON CUNARD STEAMERS.—The steamer "Umbria," of the Cunard line, has been equipped with a complete set of Marconi wireless telegraph apparatus, and her sister ship, the "Etruria," will soon be similarly provided. The steamers "Campania" and "Lucania," of the same line, have been fitted with the system for some time, and are using it with much success. The "Lucania," which arrived at Queenstown on Sept. 21, from New York, communicated with the "Campania" in midocean and going in the opposite direction. According to reports by cable, the shortest distance between the two steamers during the time they communicated with each other was 33 miles and the longest 65.

THE PROPOSED PACIFIC CABLE.—In our issue of Sept. 28 reference was made to the incorporation of the Commercial Pacific Cable Company for the purpose of laying a telegraph cable across the Pacific Ocean from the United States. The matter has been brought to the attention of President Roosevelt, and is now receiving the consideration of the Cabinet. A Washington dispatch states that President Roosevelt and his advisers look favorably upon the enterprise. The company is seeking Government permission to land its cable upon the shores of the United States, the Hawaii Islands and the Philippines. The President has referred the matter to the Attorney-General for his opinion on the legal points involved. The business of the Government will be allowed right of way over all commercial business, and in time of war the cable will be turned over to the United States. The company offers to guarantee the completion of 8000 miles of the cable within eight months. It does not ask for a monopoly.

TANGENTIAL TRACTION ELECTRIC RAILWAY SYSTEM.—Referring to the description in our issue of last week of the tangential railway system of MM. Dulait, Rosenfeld and Zelenay, of Charleroi, Belgium, we have received further information concerning details as follows: Current is transmitted along the line at 15,000 volts, and transformers at intervals reduce this voltage to 5000 and supply the windings of the track stator. The stator is divided into sections of about 1600 ft. each, and the phases are grouped in star relation by a switch controlled by a small three-phase motor shown in Fig. 1 of the article of last week. This switch is operated at the instant the axle of a car comes on a given section. The rotor of the little motor is normally in an open circuit, which is closed by the axle of a car, the motor then operating the switch whereby current is admitted to the section entered. A counter-weight again opens the circuit when the car has passed from the section considered. The air-gap, or distance between the track stator and the construction on the car corresponding to the induction motor rotor is about half an inch. With this large air-gap the reluctance is, however, small, owing to the large area which the arrangement permits to be used, and the induction is reduced to about 1000 gausses.

LETTER TO THE EDITORS.

Theory of the Edison Nickel-Iron Cell.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with great interest the full account of the discussion which followed Dr. A. E. Kennelly's Institute paper on the new Edison iron-nickel cell, as published in the recently issued Nos. 6 and 7 of the A. I. E. E. *Transactions.* I should like to make, with your permission, a few remarks on the electro-chemical theory of this cell, and more especially on some points about which there seems to be no general agreement.

Any one who undertakes at present to develop a theory of the Edison cell, must, of course, rely upon the correctness of the principal claims made by the inventor that the electrolyte is not changed and that the total result of a charge and of a discharge is that oxygen

disappears at one electrode and that the same quantity appears at the other electrode. Dr. Kennelly's statement that the cell is an "oxygen-lift," seems therefore quite a happy characterization of the general resulting action in the cell. On the other hand, several speakers in the discussion, and more especially Mr. C. O. Mailloux, have rightly pointed out that it would be of interest to sketch the ionic mechanism by which the transfer of oxygen is brought about. Dr. Kennelly says about this oxygen transfer: "Now, the action, of course, by which this transfer takes place is much more complicated, and I have not attempted to carry it out; in fact, I do not know it. Unless we all know accurately what the compound was and just exactly what the salt of nickel was—it is only assumed to be nickel peroxide—we could not attempt to map exactly the actions that occur." I do not think that the latter argument can be sustained; in fact, there is no reason whatever to defer a discussion of the mechanism of ionic migration in the electrolyte on account of our ignorance of the exact chemical constitution of the electrodes. When we know what the electrolyte is and when we also know that the only change in the electrodes is that the one is oxidized and the other gives off oxygen, we possess all the data required to sketch the mechanism of ionic migration in the electrolyte.

Indeed, we are able to form an idea of what takes place in the electrolyte, from several points of view. For instance, from the old-fashioned one which lays the whole stress upon the water and assumes that it is the water which is decomposed in an aqueous solution, with the result that hydrogen is set free at the cathode and oxygen at the anode. If we could assume this to be the case in the Edison cell, we would, during discharge, get the following reactions of the hydrogen and oxygen ions with the nickel peroxide and iron electrodes, respectively:

$$Ni\,O_2 + H_2 = Ni\,O + H_2O$$
$$Fe + O = Fe\,O$$

The nickel hyperoxide is reduced, the iron is oxidized. Furthermore, the equations show that when one H_2 ion an one O ion are set free at the electrodes—which represents the disappearance of one H_2O molecule in the electrolyte—another H_2O molecule is formed at the nickel plate, so that the constitution, the quantity and the concentration of the electrolyte are not changed.

This view leads therefore to a general explanation of the claims regarding the resulting action in the Edison cell. But it is, as I said before, based upon somewhat old-fashioned assumptions. Since the so-called electrolytic dissociation theory has come into fashion, we take a view nearly opposite to that just sketched, and assume that the water is inactive and that in a KOH solution, as in the Edison cell, it is the positive K ions and the negative OH ions which, traveling with certain speeds, accomplish the transportation of electricity through the electrolyte. A theory of the electro-chemical action of the Edison cell, based upon the views of the dissociation theory, was given by me in this journal in its issue of June 29, 1901. I have shown there that the general resulting action in the Edison cell can well be explained in this way, and I have also drawn conclusions there as to local concentration changes at the elecrodes which will enable an examination of this theory to be made by experiment.

What I want to emphasize here is that the conclusions drawn in my former article are in no way dependent upon the chemical constitution of the electrodes. The lifting of one atom of oxygen through a given KOH solution from one electrode to the other must be brought about by a certain mechanism of ionic migration, and this mechanism cannot depend upon the constitution of the electrodes. This mechanism must be the same in the Jungner silver-copper cell as in the Edison nickel-iron cell. It must be the same whether the chemical constitution of the nickel electrode at the start of discharge of the Edison cell is $Ni\,O_2$ or Ni_2O_3, or something else—if only the resulting action is the disappearance of one atom of O at this plate. It must be the same whether $Ni\,O_2$ is reduced to Ni O—as I had assumed, in order to write the equations in a convenient and easy way—or $2\,Ni\,O_2$ to Ni_2O_3—which Professor A. L. Marsh considers to be more probable (ELECTRICAL WORLD AND ENGINEER, July 27). As I have said in my former article, the conclusions drawn there regarding the processes in the electrolyte, are independent of the nature of the electrodes—always supposing, of course, that the only change in the electrodes is the transportation of oxygen from the one to the other.

While the mechanism of the ionic migration and the phenomena immediately resulting therefrom, such as local concentration changes at both electrodes, do not depend upon the chemical nature of the electrodes, the latter is of importance for the e. m. f. of the cell. For, if we neglect the small correction term, due to the coefficient of the e. m. f. of the cell, we can calculate the e. m. f. from the heat-toning of the resulting chemical action by means of Thomson's rule. Thus, if we assume that the resulting chemical reaction in the Edison cell is

$$Ni\,O_2 + Fe = Ni\,O + Fe\,O,$$

the e. m. f. of the cell corresponds to the difference of the formation heat of Fe O (from Fe and O) and the formation heat of $Ni\,O_2$ (from NiO and O). If, however, the chemical reaction is

$$2\,Ni\,O_2 + Fe = Ni_2O_3 + Fe\,O,$$

the e. m. f. corresponds to the difference of the formation heat of Fe O (from Fe and O), and the formation heat of $2\,Ni\,O_2$ (from Ni_2O_3 and O). Should, however, the nickel compound at the beginning of the discharge not be $Ni\,O_2$ at all, but perhaps Ni_2O_3, and the resulting chemical reaction

$$Ni_2O_3 + Fe = 2\,Ni\,O + Fe\,O,$$

the e. m. f. corresponds to the difference of the formation heat of Fe O (from Fe and O) and the formation heat of Ni_2O_3 (from 2 Ni O and O).

Only for the third of these three cases are the numerical thermochemical data available. The formation heat of Fe O corresponds to 1.47 volts. According to Michalowski, the combination of 2 Ni O and O to Ni_2O_3 is an endothermic reaction, corresponding to —0.04 volt. The e. m. f. of the nickel-iron cell would therefore be $1.47 - (-0.04) = 1.47 + 0.04 = 1.51$ volts. The initial voltage of discharge of the new Edison cell after recent charge is given by Dr. A. E. Kennelly as 1.5 volts. The question which of the above reactions—or, perhaps, still another—takes place in the Edison cell, is also of importance for calculating the weight of active nickel compound required for a given number of ampere-hours, as has been pointed out by Professor Marsh.

I should like to take this opportunity to make a few belated remarks on the editorial in your issue of July 6 in which you have been good enough to discuss my article in the preceding issue. You say that "Superficial concentration changes would necessarily occur by the electro-chemical combinations formed, even if the ions did not move past one another." This is exactly correct so far as it goes, but it is insufficient for the complete calculation, as will be seen at a glance, when one considers the two equations which I have given for the reactions at the two electrodes:

$$Ni\,O_2 + 2\,K + H_2O = Ni\,O + 2\,K\,O\,H$$
$$Fe + 2\,O\,H = Fe\,O + H_2O$$

These equations show that there disappear from the electrolyte 2 K ions and 2 O H ions which represents the disappearance of 2 KOH molecules from the electrolyte; further, on account of the chemical combinations formed at the electrodes, there disappears at the nickel plate one H_2O molecule, and there are formed 2 KOH molecules at the nickel plate and one H_2O molecule at the iron plate. We know exactly where the latter changes take place—those which are due to the chemical combinations formed at the electrodes. But from the above equations, we cannot say the exact locality where the two K O H molecules disappear in the electrolyte which furnish the two K ions and the two OH ions set free at the electrodes. To complete the calculation, one must have recourse to the experimentally determined "transport numbers," as I have done in my former article.

In another part of the editorial you say that "while variations of concentration tend to occur at the electrode surfaces during charge and discharge, yet owing to the thinness of the solution layer these variations can readily cancel and annul each other by diffusion." This statement in this form seems to me misleading. "Surface" of an electrode, in the electro-chemical sense, is not only the outside visible surface, but includes also any part of the electrode at which electro-chemical action takes place. The outside visible surfaces of two opposite electrodes are very near together in the Edison cell. In the beginning of the discharge the molecules of the iron and nickel compounds in these outer layers will be oxidized and reduced and concentration changes tending to develop there may easily annul another. But when the discharge goes on, the outer layers of the active masses will have been oxidized and reduced, respectively, and the seat of electro-chemical action (the "surface" of the electrodes in the electro-chemical sense) will be transferred into the inner parts of the porous active masses. Concentration changes will then develop in the electrolyte in the pores of the active masses, and these concentration changes cannot so easily cancel each other.

Although, for the reasons given in my former article, I believe that diffusion acts quicker in the new Edison cell than in the lead

accumulator, yet local concentration changes should become observable in the Edison cell, especially with quick discharges or charges. It must be considered that in order that the concentration changes can annul one another, the electrolyte must pass through the outer pores of the active masses which act somewhat like a diaphragm. It is a well-known experimental fact that when a lead accumulator has been charged and is allowed to rest on open circuit, the concentration of the electrolyte between the plates increases for quite a while. Such an increase has been observed in lead accumulators of the pasted grid type for even 48 hours after completed charge (Pfaff. *Zeitschr. f. Accumulatoren und Elementenkunde,* 1901, June 15). This is evidently due to the fact that during charge the concentration in the pores of both plates had become higher than the concentration of the acid between the plates, and it shows how slow the action of diffusion is in this case in annulling the differences of concentration.

PHILADELPHIA, PA. E. F. ROEBER.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS

Commutating Dynamo Machinery.—HOBART.—An abstract of his Glasgow Internat. Eng. Congress paper on "Modern commutating dynamo machinery, with special reference to the commutation limits." One persistent error has been the assumption that the kilowatt output should be given predominating consideration in laying down the lines of the design, and that the required voltage and amperage are of altogether minor importance. Machines of different voltages, but for the same kilowatt output have, however, one set of features in common, namely, the mechanical design in general. He describes a group of machines designed with due regard not only to these features of mechanical similarity, but also to the points where the designs should diverge in order to suitably comply with the requirements of different voltages and current ratings. In these machines the base, stands, bearings and shaft are the same for all voltages, but while in the low voltage design the electromagnetic part of the machine is extremely narrow and the commutator wide, the high voltage machine has precisely the opposite characteristics. Since, however, the diameter of commutator, armature, field bore and magnetic yoke, are the same for all voltages, it is quite practicable to use to a great extent the same drawings and patterns for all voltages, the patterns being extended or not, according as castings for machines of the one or the other voltage are required. It is shown how naturally all this works out, and the opinion is put forth that by the use of these principles the best results for a given outlay may be obtained. Incidentally, the assertion is made that low reactance voltage greatly outweighs in importance low armature strength so far as relates to excellence in commutation, and high commutator peripheral speeds are advocated on account of the very great improvement in commutating constants which are thereby rendered practicable. Careful attention to all these different considerations still permits of a fair degree of interchangeability and uniformity in the designs for different voltages of the same kilowatt output. He discusses in detail his method of estimating the reactance voltage. Incidentally, he remarks that the inductance of a coil laid upon the surface of a smooth core armature is, with customary proportions, rarely much less than one-third and often one-half or more as great as in the case of the same coil laid in slots. He considers the case of large high-speed commutating machines, and states that by the use of high armature reaction—as expressed in armature ampere turns per pole piece, and high commutator peripheral speeds, even 600-volt machines of large capacity may be designed with excellent commutating properties for high speeds.

In the discussion which followed, S. P. Thompson said that the reactance voltage is not really the crucial quantity to be considered in connection with satisfactory commutation. No one has experimentally investigated what goes on in the moment of commutation. The current has to change from a positive to an equal negative value, and it cannot do this instantaneously. He denied the correctness of Hobart's assumption that the connecting curve is a sine curve smoothly joining the two steady currents before and after commutation. In his opinion the real determining factor in commutation is the width and resistance of the brush in contact with the commutator strip. Chamen said that the difficulties with commutating large dynamos are mechanical and not electrical.—Lond. *Elec.,* Sept. 20.

Direct-Current Dynamo Design.—MAVOR.—A long abstract, with diagrams, of his Glasgow Internat. Engin. Congress paper. The essential part of a dynamo is the region occupied by the armature conductors in the magnetic field. This region he calls the "active belt" of the armature. It is bounded by the peripheral surface of the armature, the surface of the core at the bottom of the slots and the ends of the core. An examination of the machine in the terms of the energy generated in this "active belt" leads to the interesting result that machines of very widely varying size, output and speed, give a remarkably constant value in watts generated per cubic centimeter of active belt at unit velocity in unit field. This value he believes to be about 0.0000005, or 5 ergs per second per cubic centimeter at unit velocity in unit field. The greater part of the paper is chiefly mathematical and cannot well be abstracted. Regarding the cost, he finds that in the case of many groups of machines there is no regular ratio between the cost and the output. There ought to be, however, and the following method is suggested for obtaining this result: Plotting watts per revolution as abscissas and costs as ordinates, the position of each machine is marked, and the points representing cost and output for each carcase of a given diameter with varying length are joined by a straight line which is produced to the origin. The point where this line cuts the zero ordinate gives the limit of cost to which this carcase approaches as the core length is reduced to zero, and may be called the base cost of any given carcase. An increase in diameter increases the base cost and reduces the slope of the line passing through the costs of the actual machines, so that, starting from the smallest diameter and passing to the largest, will give a succession of straight lines, each touching its next lower neighbor at one point, and producing a curve made up of segments of the lines representing each machine, each segment showing the economical range of length for the machine which it represents.—Lond. *Elec.,* Sept. 20.

REFERENCES.

Theory of the Short-Circuited Alternator.—HORSCHITZ.—A communication, being a supplement to his article abstracted in the Digest, Aug. 3. He gives the curve of the short circuit current as a function of the frequency at constant exciting current for a three-phase alternator, and develops the numerical formula.—*Elek. Zeit.,* Sept. 12.

Large Direct-Current Generators.—ROTHERT.—A communication referring to the article of Hobart recently abstracted in the Digest. He agrees in general with the principle of Hobart, except that Hobart favors a somewhat higher number of poles. He makes a few critical remarks on details of design of the machines of the Gen. Elec. Co. and of Hobart.—*Elek. Zeit.,* Sept. 5.

Direct-Current Generators.—An illustrated description of large direct-current generators, made by the English Elec. Man. Co. at Preston.—Lond. *Elec. Rev.,* Sept. 20.

LIGHTS AND LIGHTING.

REFERENCE.

Arc Lamp with Three Arcs.—An illustrated description of a 110-volt arc lamp with three arcs, without any resistance in series, so that no energy is wasted. Preliminary photometric measurements show that this lamp gives a better illumination than an arc lamp with a single arc or with two arcs; but the consumption of carbons is slightly greater.—*Elek. Anz.,* Aug. 25.

POWER

REFERENCES.

Water Power Plant in Bosnia.—J. B. C. KERSHAW.—An illustrated description of the electric power plant at Jajce, a small town in Bosnia. The power house contains 10 turbines, eight of 1000 horse-power each, two of 632 horse-power each. The larger ones drive

three-phase generators, the smaller ones direct-current machines. The power from the plant is used in the manufacture of calcium carbide, alkalies and chlorine in neighboring works. Each of the alternators delivers 3000 amperes at 350 volts, and this current is used to operate three carbide furnaces. The two direct-current machines deliver together 7200 amperes at 120 volts. This current is used in the adjoining works for the production of alkalies and chlorine. The current from the alternating generators is carried to the carbide works by 96 bare copper cables, each cable being made up of 19 ¼-inch wires, and the total sectional area of each cable is thus 0.93 square inch.—*Cassier's Mag.*, Oct.

Electric Hoists.—HALL.—An illustrated article on the successful operation of electric hoists on the Comstock. A continuous rope electric hoist is used, driven by means of a variable speed, three-phase induction motor. The variations of the motor are secured by non-inductive resistances inserted in both primary and secondary. —*Jour. of Elec.*, Aug.

Electric Traction Battery Tests.—R. KENNEDY.—An article in which he says that long-run trials of automobiles do not prove anything concerning the value of the batteries, except the durability of the cells if the runs are repeated often enough. Such runs are really tests of the car as a whole. How much or how little of the success is due to the battery cannot be known. Batteries for automobiles can be well tested only on the road, but the same car on the same road must be run under the same conditions with several different sets of cells. He proposes that a test should be made of batteries, open to all makers, the car battery to be made up of so many cells of each manufacture, coupled up to form one battery on one car, say, 10 competitors each to put in four cells to make a battery of 40, and no series parallel battery coupling to be allowed. From the tests the watt-hours are ascertained per pound of cell of each make. The car run is to be stopped when the cells of any make drop to 1.7 volts, with the normal current flowing, and the remaining cells are discharged at normal rate until down to 1.7 volts. The last cell to drop to this p. d. is to be adjudged the best.—Lond. *Elec. Rev.*, Sept. 13.

REFERENCE.

Automobiles.—MUELLER.—The first parts of a serial on "The solution of the problem of the electric automobiles." He deals with details of mechanical construction and thinks that the greatest improvement can be expected from an increase of the wheel diameters. He discusses at great length the mathematical theory of the effect of such an increase.—*Centralblatt f. Accum.*, Aug. 15, Sept. 1, 15.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Relative Advantages of Three, Two and Single-Phase Systems.—FIELD.—A very brief abstract of his Glasgow Internat. Eng. Congress paper on "The relative advantages of the three, two and single-phase systems for feeding low-tension networks." He advocates the use of three-phase currents for feeding low-tension networks in all cases except exclusively for electric lighting. With mixed systems, i. e., those for both lighting and power, he inclines towards the use of a three-phase network with the motors on all three circuits, the lamps being placed on only one circuit. In this system regulation can be effected by controlling the pressure on the lamp section alone, the motors tending to equilibriate the system as a whole. In the discussion which followed, several speakers expressed the opinion that the three-phase system is the final goal towards which all electrical engineering is rapidly tending. S. P. Thompson considered there was room for several systems. In changing over from single-phase to polyphase working it is often advantageous to use the two-phase system, building up the circuits on the single-phase first and then transferring to the two-phase when all the circuit arrangements are completed. He also recalled that Ferranti is still the apostle of single-phase working, and has never even in spite of all the modern developments of large three-phase plants, changed his opinion that in the end we shall have to get back to single-phase machinery for every branch of electrical engineering.—Lond. *Elc., Eng'ing*, Sept. 20.

Rates of Charging for Electrical Energy.—KALLMANN.—A very long article, illustrated by diagrams. In recent years two different systems of charging have been introduced into practice: One the so-called maximum demand system, the other a system in which different tariffs are used for charging for different hours of the day. Both systems are more just and adequate than the older ordinary system of charging. Nevertheless, he thinks that each of them is somewhat one-sided, and does not take into proper consideration all the important points. A strictly just system would consider the whole load diagram, as follows: For each month, or for summer and for winter, any electric station has a characteristic load curve which represents the average value of the load curves of all consumers. The area of this curve can be used as base of the tariff, in such a way that a consumer whose average load curve is equal to the average load curve of the generating station, has to pay the fixed average price per kilowatt-hour, which is calculated from the fixed expenses of the generating plant and the costs of operation. If the average load curve of the consumer is inside the average load curve of the plant, the consumer has to pay more than the average price, because the fixed expenses are then to be distributed on a smaller number of kilowatt-hours. On the other hand the consumer has to pay a lower price, if his load curve extends beyond the load curve of the plant. The price the consumer has to pay varies, of course, between a maximum and a minimum, for instance, between 4 cents and 15 cents per kilowatt-hour. To use a system based upon these principles, in practice, an automatic instrument is required which takes the place of the registering instrument, and which takes into account properly the ordinates as well as the abscissas of the load curve. The area between the load curve and the axis of abscissas represents the total energy. He divides this area into three parts or stages by straight lines parallel to the axis of the ordinates. The first part corresponds to loads below 20 per cent full load, the second to loads between 20 and 50 per cent full load, the third to loads between 50 and 100 per cent full load. The area of each of these three parts can evidently be represented by a rectangle, the base (abscissa) representing the number of hours during which the load was in that certain stage, while the height (ordinate) represents the average value of the load in that certain stage. The area of each rectangle therefore represents the total energy corresponding to the stage of load. When the consumer has used up the amount of energy corresponding to the average load curve of the plant, the fixed expenses are covered, and for the energy above that amount, a lower price is charged. The instrument needed for such a method of charging must therefore register separately the energy of each stage. For small electric plants a time counter with three dials is practical, which consists of a clockwork and a triple relay, one armature of which is attracted at a load of, say, 5 per cent full load, with the result that the time at which the load is above 5 per cent, but below 20 per cent, is counted on the first dial. When the load reaches 20 per cent, a second armature is attracted and the time at which the load is between 20 per cent and 50 per cent is counted on the second dial. In the same way the time at which the load is above 50 per cent is counted on the third dial. For larger electric plants he recommends using two different stages, the lower stage corresponding to loads below 33⅓ per cent, and the higher to loads above that value. He illustrates the method by the following numerical example: An installation has 2 arc lamps and 20 incandescent lamps of together 1.8 kilowatts or 16.3 amperes at 110 volts. The energy consumed for loads at and above $\frac{1}{3} \times 1.8 = 0.6$ kilowatts, and the energy consumed at lower loads is counted separately. For any 20 hours in each stage 1 per cent discount is allowed up to a maximum discount of 50 per cent. An interval of 20 hours of operation corresponds, for the lower stage, to $20 \times \frac{1}{3} \times 1.8 = 12$ kilowatt-hours, and for the higher stage to $20 \times 1.8 = 36$ hours; in other words, for any 12 kilowatt-hours in the lower stage and for any 36 kilowatt-hours in the higher stage a discount of 1 per cent is allowed. Let the energy consumed in the year in the higher stage be, say, 443 kilowatt-hours, and in the lower stage 512 kilowatt-hours, so that the total energy consumed is 955 kilowatt-hours, and let 15 cents be the fundamental price for 1 kilowatt-hour, then the discount is $512 \div 12 = 43$ per cent in the lower stage and $443 \div 36 = 12$ per cent in the higher stage. While the total price, calculated from the fundamental price of the kilowatt-hour, is $143.25, the discount allowed on the lower stage is $33.02 and on the higher stage $7.98, so that the consumer has to pay, on the whole, $102.25, i. e., about 10 cents instead of 15 cents per kilowatt-hour. He pays for the kilowatt-hour in the lower stage about 8.6 cents and in the higher stage about 13.2 cents. A consumer who burns a few lamps for long hours therefore gets the energy at a lower price; on the other hand, the price charged is profitable to the station.—*Elek. Zeit.*, Aug. 22.

British Supply Station.—The conclusion of the illustrated article on the Kensington and Notting Hill companies' joint electric supply works, the first part of which was recently abstracted in the Digest. Some electrical notes are also given on the plant. Simplicity is said to be the keynote of this system, and is obtained in a large measure by the use of synchronous motor generators, and that efficiency has not been ignored is evident from the use of boilers working at 200-lbs.

pressure with triple expansion engines. Owing to the fast-speed engines, the generating sets are exceedingly compact.—Lond. *Elec.*, Sept. 20.

Cedarburg.—An illustrated description of the alternating-current lighting plant at Cedarburg, Wis. There are two 60-kw, 1100-volt single-phase alternators. Arc and incandescent lamp service is supplied from the station. There are two alternating-current series arc lamp circuits each of 25 lamps, the current being supplied from two 15-kw transformers raising the voltage to 2200, which is the voltage of the arc circuits. The incandescent lamp service consists of four two-wire circuits with a total capacity of 1200 lamps of 16 candle-power. The distribution is made at 1100 volts, the current being transformed by transformers "at the points of distribution" to 110 volts.—*West. Elec.*, Sept. 28.

Wires, Wiring and Conduits.

Disruptive Strength of Insulating Materials.—O'Gorman.—A communication referring to Baur's paper, recently illustrated in the Digest. He thinks that the evidence, given by Baur, is not sufficient to prove for his general formula that the breakdown voltage is proportional to the two-thirds power of the thickness. A straight-line law should be expected. For a dielectric thickness of more than ½ or 1 cm, the dielectric strength curve is sensibly parallel to the axis of the thickness.—Lond. *Elec.*, Sept. 20.

REFERENCES.

Transmission Line.—Dutcher.—A paper, read before the convention of the Pac. Coast Elec. Transm. Ass'n on the Bay Counties transmission line, which, for reason of safety against breakdowns, has been made a double line. One line carries No. 00 B. & S. gauge medium hard-drawn copper, and the other No. 0000 seven-strand aluminum—the equivalent of No. 00 copper.—*Jour. of Elec.*, Aug.

Pole Line Construction.—Poole.—A profusely illustrated paper, read before the convention of the Pac. Coast Elec. Transm. Ass'n on "Some details of high-tension pole line construction," used by the Standard Elec. Co., of California. The problems of pole-line construction are also discussed editorially.—*Jour. of Elec.*, Aug.

Electro-Physics and Magnetism.

Atoms and Electrons.—Sutherland.—A study of "The cause of the structure of spectra," bringing out the result that the atoms of the different elements are all equipped with the same, or nearly the same, electrical apparatus, whereby the mechanical energy of the atom is made communicable to the ether for radiation. The atom with the kinetic energy assigned to it in the kinetic theory of matter, exercises no direct mechanical effect on the ether, but is like a flywheel driving the dynamo to which we may liken the electrical equipment of the atom, i. e., the arrangement of electrons. He gives an extended analysis of Balmer's and Rydberg's laws for the wave lengths of spectrum lines, and traces the structure of spectra to two facts, first, that atoms vibrate as deformable but practically incompressible bodies of finite calculable rigidity, so that their surfaces have stationary waves corresponding to the fundamental mode of vibration and its harmonics, and, second, that electrons in describing nearly circular orbits round an atom, out of an infinity of such orbits possible, have orbits of certain frequencies made predominant by resonance. The orbits for a positive electron are different from those for a negative, and therefore a relative motion between positive and negative electrons is set up. This is the direct cause of the vibrations of light. This relative motion can be represented by giving the positive and negative electron different angular velocities round the circumference of a circle. By such motions, Balmer's and Rydberg's formulæ can be explained, and Rydberg's laws lead to the conclusion that the fundamental angular velocity of all electrons associated with all atoms is a constant representing a frequency of 33 times the 14th power of 10 per second. The spectra of different elements appear to be caused by practically one and the same form of electrical appliance—pair of electrons—which is supplied with energy by the atom at various internodes. One spectrum is only a slight kinematical variation of the other.—*Phil. Mag.*, Sept.

Reality of Atoms.—Ruecker.—The first part of his highly interesting presidential address to the British Assn. for the Adv. of Science. He speaks of the hypotheses and assumptions on which the fabric of modern theoretical science has been built, and inquires whether the foundations have been so "well and truly" laid that they may be trusted to sustain the mighty superstructure. The three chief conceptions are the existence of atoms, of the mechanical nature of heat, and of the existence of the ether. It is well-known that of late doubts have arisen as to whether the atomic theory, with which the mechanical theory of heat is closely bound up, and the theory of the existence of an ether, have not served their purpose, and whether the time has not come to reconsider them. The fundamental question is whether these theories are to be regarded as accurate descriptions of the constitution of the universe or merely as convenient fictions, as diagrams or models. If the laws of the working of the model could be expressed by abstractions, as, for example, by mathematical formulas, then when these formulas are obtained, the model might be discarded as probably unlike that which it was made to imitate. The model would therefore be not an essential part of science, but only an aid of thinking. He agrees that great progress in physical science has been made without the aid of the theory of atoms. "A great school of chemists, building upon the thermo-dynamics of Willards Gibbs and the intuition of Van't Hoff, has shown with wonderful skill that, if a sufficient number of the data of experiment are assumed, it is possible, by the aid of thermo-dynamics to trace the form of the relations between many physical and chemical phenomena without the help of the atomic theory." But this method deals only with matter as our coarse senses know it. It does not pretend to penetrate beneath the surface. He strongly asserts that the exposition of such a system of tactics cannot be regarded as the last word of science in the struggle for the truth. He asserts that atoms are real. He refers to the rings of Saturn which appear to be continuous masses separated by circular rifts; but from Maxwell's mathematical calculations and Huggins' spectroscopic observations we know that the rings are not continuous masses, but minute moonlets, closely packed, but separate from one another. "A physicist who believes in the reality of atoms thinks that he has a good reason for dividing an apparently continuous gas into molecules as he has for dividing the apparently continuous Saturnian rings into satellites." He inquires first whether there is valid ground for believing that all matter is made up of discrete parts, and, secondly, whether we can have any knowledge of the constitution or properties which those parts possess. He discusses the "coarse-grainedness of matter," and refers to the phenomena of diffusion and expansion of gases, liquids and even solid bodies. Austen has placed pieces of gold and lead in contact at a temperature of 18 degs. C. After four years the two metals were united and appreciable quantities of gold were detected even at a distance of more than 5 mm. from the surface. These phenomena can only be explained by the hypothesis that matter consists of discrete parts in a state of motion. The phenomena of heat can only be explained by the supposition that heat is a mode of motion; and if that is so, it is the fundamental particles of matter which are moving. These and other considerations are the fundamental proofs of the atomic theory; but they give no evidence as to the nature of the particles or granules into which matter must be divided. The paper is to be concluded.—Lond. *Elec., Elec. Eng.*, Sept. 13.

Graphical Combination of Vectors.—Emde.—A communication on the principles underlying the graphical combination of fluxes and m. m. f.'s. The parallelogram of forces and Fresnel's theorem must be distinguished. While magnetic fluxes and m. m. f.'s are no vectors, they can be graphically combined as if they were vectors.—*Elek. Zeit.*, Sept. 22.

Effects of Magnetization Upon the Electrical Conductivity.—Barlow.—A brief abstract of a Brit. Ass'n Adv. Sc. paper on the effects of magnetization upon the electrical conductivity of iron and nickel. He found that the effect is very marked, being greater than can be accounted for by change of length and diameter of the magnetized wire. The increase in the electrical resistance is found to vary approximately as the square of the magnetic induction, there being a second term varying as the fourth power, and a third term varying as the sixth power of the induction.—Lond. *Elec.*, Sept. 20.

Electro-Chemistry and Batteries.

Electrolytic Production of Caustic Alkali and Chlorine.—Cohn and Geisenberger.—The production of caustic alkali and chlorine by the electrolysis of solutions of chloride of the alkalies, has the disadvantage that a diaphragm is required and that the caustic alkali produced must be separated from the chloride of the alkali with which it is mixed. To overcome these disadvantages, the authors carry out the process in the cold, with the result that the caustic alkali produced is deposited in solid form so that it cannot mix with

the alkaline chloride or with the chlorine. An apparatus for this purpose is described and illustrated.—*Elektrochem. Zeit.*, Sept.

Determining the Constitution of Complex Salts from Electrolytic Transport Numbers.—RIEGER.—The conclusion of his article. He found that in potassium copper sulphate, potassium silver iodide, potassium mercury iodide, potassium zinc cyanide, potassium cadmium cyanide, potassium ferro-oxalate and potassium ferri-oxalate, the nobler metal goes to the anode, and is therefore in all these salts to be considered as a portion of a complex union.—*Zeit. f. Elektrochemie*, Sept. 5.

REFERENCES.

Discharge of Storage Batteries.—MONTEL.—An article in which he tries to develop mathematical formulæ for the process of the stopping up of the pores of the lead peroxide plate, when it is changed into lead sulphate. He arrives finally at Liebenow's empirical formula for the capacity of the lead storage battery as a function of the discharge current. The capacity is inversely proportional to the sum of unity and the product of a constant times the discharge current. This formula is valid for not too high a current density.—*Centralblatt f. Accum.*, Sept. 1.

Automobile Storage Battery.—A description of the "Progress accumulator," with accounts of the results of tests. The figures given do not seem to agree with each other.—*Elektrochem. Zeit.*, Sept.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Permeability.—BAILY.—An abstract of a Brit. Ass'n Adv. Sc. paper on a new method for measuring the permeability of iron and steel and other high permeability samples. The apparatus depends on the measurement of the ratio of B to H in the sample. A complete magnetic circuit is formed by two lengths of the sample joined by short iron blocks at the ends. Magnetizing coils are placed round the samples. In one of the blocks is a narrow gap perpendicular to the direction of the lines of force. Above this is pivoted a pair of astatic magnets. The lower magnet is influenced by the difference of magnetic potential between the two sides of the gap, the force being proportional to B. Round the upper magnet is placed a small coil in series with the main magnetizing coils, which acts on the magnet with a force proportional to H. Using the principle of the sine galvanometer, the coil is rotated until the two forces are balanced, the position of the magnet system being along the line of the gap. The coil is shaped to give an almost uniform scale through some 80 degs. of arc, and the permeability is read directly on the scale. The scale is calibrated for a standard size of specimen, and the value for any other size is obtained by multiplying by the ratio. A wide range is obtained by using only a part of the magnetizing coils when the permeability is high. The magnetizing force is read on a separate instrument, such as a suitable ammeter.—Lond. *Elec.*, Sept. 20.

Electricity Supply Meters of the Electrolytic Type.—DICK.—A long abstract of a Glasgow Internat. Eng. Congress paper in which he dealt with shunted electrolytic meters, and especially with such in which mercury is deposited from a mercurous salt. When a shunt is used in connection with an electrolytic meter which has a back e. m. f., some compensating e. m. f. has to be inserted in the cell circuit in order to obtain a constant linear ratio between the main and shunt currents. Wright does this in several ways. "The most practical method is to place a shunt R across the mains and to interpose a portion r of this resistance R in the cell circuit, such that with a back e. m. f. in the voltameter of 1.5 volts, the ratio $r:R$ is the same as 1.5 to the supply pressure. The resistance r will then counterbalance the e. m. f. of the cell, and no current will flow through the cell when there is no current in the mains." It would be preferable, however, to use an electrolytic cell without any back e. m. f. Mercury salt cells, generally mercurous nitrate, which is very soluble, offer the great advantages that their e. m. f. is very low, and that the mercury liberated need not be weighed by taking the apparatus to pieces, but can be collected and measured in graduated vessels. The chief defect of former meters of this kind was that crystals would deposit at the anode surface and that the consequent increase in the resistance could not be prevented by agitation. One of Wright's meters is claimed to be free from these defects. The anode is placed above the cathode. The anode mercury is contained in a circular trough, which is of such a height that the concentrated solution formed by the electrolytic action falls off the curved surface of the mercury by gravity and mixes the liquid. This diffusion by gravity would become ineffective if the mercury in the anode were to sink below the level of the lip of the trough, but this is prevented by adding an anode feeder which resembles a "bird fountain." As the lever of the anode mercury is lowered by electrolysis, the flow from the anode feeder restores the mercury level in the trough while a corresponding amount of solution replaces the mercury thus withdrawn from the trough. The cathode is a hollow cone of platinum or carbon concentric to the anode trough. The mercury deposited falls into a glass funnel and a siphon V-tube. When this siphon tube has received mercury equivalent to 100 units, the siphon will come into play and the whole mercury be drawn into a graduated receptacle. The temperature coefficient of the electrolyte is negative, that of the resistance in series with it positive, thus a constant total resistance can be secured. To avoid the necessity of using two meters in a three-wire system, he splits the neutral wire into two equal low resistances, and connects the meter across the ends of these resistances. The current through the cell will then always be proportional to the sum of the currents in the two halves of the installation. After eight months of working these meters under conditions equivalent to five years of ordinary installation practice, the proportion of mercurous nitrate in the solution was found unaltered, and only traces of mercury nitrate could be detected. "The lingering objections to electrolytic meters should therefore vanish."—*Eng'ing*, Sept. 13.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Lines on Power Transmission Pole Lines.—Some editorial remarks on the experiment successfully tried and adopted by the Bay Counties Power Company, in which the telephone line between the Colgate power house and the Oakland sub-station is run on one of the pole lines carrying the 40,000-volt, 132-mile power circuit straight, i. e., without transposition in the telephone circuit. Reference is made to a statement of an Italian engineer, Semenza, in a report on the Paderno-Milan transmission line, in which he says that "the noises disturbing the telephone are caused by electrostatic induction; in our case, at least, electromagnetic induction gives no trouble. Our telephone circuits are not transposed or spirallel. Nothing has been done to counteract electromagnetic induction. Nevertheless, the noise has been almost entirely suppressed by very carefully insulating all parts of the telephone circuit from the ground." This agrees perfectly with the opinion expressed by Theberath that non-transposed and adequately insulated telephone circuits will give the nearest approach to perfect telephone service over circuits run on long-distance high-tension pole lines.—*Jour. of Elec.*, Aug.

Brussels.—An illustrated description of the new telephone exchange of Brussels. The central battery system of the Western Elec. Co., of this country, is used.—*Elek. Zeit.*, Sept. 12.

MISCELLANEOUS.

Comparison of American and British Methods.—An article by a British electrical engineer who attended the recent Am. Int. E. E. annual meeting. The causes of difference in the practice of the two countries are said to be first that in America engineers have been given a practically free hand, while the British engineers were restricted by governmental regulations which have caused the advance in England, although slower, to be on firmer lines; second, the relation between labor and fuel, which has necessitated that extreme attention is paid to lavor-saving machinery in the United States, has in Great Britain rather caused the absolute efficiency of the plant to be the first consideration; third, England has a freer trade, and thereby the advantage of being able to buy all that is best abroad. He admires the beautiful systems of control and labor-saving schemes in American supply stations. He wonders that the supply voltage in lighting installations has not been raised in the United States, while it has been generally doubled in England. He doubts whether on the whole English engineers need consider themselves behind their American confreres. Where the American gains in unrestricted advance, the Englishman possibly has an advance in thoroughness of work. The extended use of movable tools is commended, as are the forming machines for armature windings. A feature of great interest is said to be at the General Electric Company's works, the motor-driven 10,000-volt oil switch, giving a remarkably quick and accurate break. "Traction, in practice, is scarcely in such a superior state as one would have expected." The conduit system in New York is said to be virtually the same system as that laid down at Blackpool some 15 years ago, while the control is up to date, the track is nearly identical. "Certainly the road surrounding the track, and often the track itself, in the heart of New York City, is in such a marvelous state of disrepair that it is a source of constant won-

derment that the accident wards are ever with a vacant bed."—Lond. *Elec.*, Sept. 20.

Engineering.—Crompton.—His presidential address to the engineering section of the Brit. Ass'n Adv. Sc. He dealt with three different subjects: Modern development of passenger and goods traffic as affecting carriage on railways, tramways and ordinary roads; standardization and interchangeability in all kinds of modern machinery, and the object of the Brit. National Standardizing Laboratory.—Lond. *Elec., Elec. Rev., Eng'ing*, Sept. 20.

Metric System.—Greenwood.—An abstract of a Glasgow Eng. Congress paper on "The adoption of the metric system in our workshops." The principal point is that its adoption is necessary to push the export trade to countries of Europe and elsewhere where the metric system is universal. The one serious objection is the cost and trouble of making the change.—*Am. Mach.*, Sept. 26.

Making Glass Electrically.—Bermbach.—An article which deals in general with the same subjects as that author's paper which was recently abstracted in the Digest, but the present article is more complete. Several arc furnaces for making glass are illustrated by diagrams.—*Elektrochem. Zeit.*, Sept.

German Manufacturing Plant.—In the continuation of the serial on the recent visit of the Brit. Inst. of Elec. Eng. to Germany, an illustrated description of the works of Schuckert & Co. is given.—Lond. *Elec.*, Sept. 20.

Berlin Exposition.—Wilking.—An illustrated review of the electrical exhibits at the present Berlin Exposition of materials for fighting fires, automatic fire alarms, fire engines with electric pumps, automobiles, etc.—*Elek. Zeit.*, Sept. 19.

New Books.

High Temperature Measurements. By H. Le Chatelier and O. Boudouard. Translated by George K. Burgess. New York: John Wiley & Sons. 230 pages, 52 figures. Price, $3.

This is a very thorough and complete text-book upon the measurement of high temperatures. It is written by an author well known to be familiar with this subject. The work is divided into thirteen chapters, with a preface to the American edition and an excellent index. The subject is dealt with both in a scientific and a practical manner, and the results of the latest methods in use in pyrometry are sketched clearly.

The following data are given as the most reliable melting and fusing points at present known:

Ebullition temperatures.—Water	.....	100	degs. C.
	Naphthelene	218	"
	Sulphur	445	"
	Zinc	930	"
Fusion temperatures.—Silver	.....	962	"
	Gold	1065	"
	Platinum	1780	"
	The sun, about.....	8000	"

It is stated that, whereas the boiling point of sulphur and other substances below its ebullition temperature may be known to 1 deg. C., the uncertainty as to the fusing point of silver and temperatures beyond may be 10 degs. C.

It is shown that high temperatures are measured (1) by gas pyrometers, which are mainly used in laboratories; (2) by calorimeters, which are simple, cheap and are used for occasional measurements in industries; (3) by electrical resistance pyrometers, originated by Dr. Siemens, which seem to have the most promising future if the determination of the law of resistance of platinum can be carried out with greater precision; (4) the thermo-electrical pyrometer employing a metallic couple, and which is much used commercially, but is not reliable for the best high-temperature laboratory work; (5) by the heat-radiation pyrometer, which is not used at present, but which offers a wide field for further advance; (6) the luminous-radiation pyrometer which gives only rough determinations; (7) the contraction pyrometer and fusible cones, much used in practice, and giving reliable comparative observations, but not the most reliable scientific determinations.

The work deserves the appreciation of all those who are interested in practical pyrometry, or high temperature measurements.

Engineering Education. Proceedings of the Society for the Promotion of Engineering Education. New York Meeting, 1900. Vol. VIII. Edited by Professors John B. Johnson, Albert Kingsbury and Henry S. Jacoby, Committee. New York: Engineering News Publishing Company. 377 pages. Price, $2.50.

This society had 266 members at the date of publication, almost all holding professorships in engineering colleges. It has a council of seven members and meets annually in connection with the meeting of the American Association for the Advancement of Science. It publishes its papers and discussions in a well-bound blue book with large type.

The condition of professional education is undergoing a distinct change, as shown by the fact that during the past 20 years the students in engineering have increased 500 per cent, those in law 300 per cent., those in medicine 140 per cent, and those in theology 87 per cent. In an average college curriculum for the education of American youth there is a distinct tendency to reduce the classics and increase the technics, for which we are all devoutly thankful.

The great purpose of educational institutions is to meet and occupy the resources of each individual applicant. There are some who can afford to devote themselves entirely during a four-year course to a technical college training, and for them a particular line of appropriate study is prepared in these institutions. There are others who can devote night work to classes, being occupied in supporting themselves during the day, and for these a correspondingly modified curriculum is adopted and prepared. A third number of students are so occupied in places remote from educational centers that while having spare time for study they have no schools available for their spare time, and for them again correspondence schools are particularly adapted. It is very interesting to observe in a perusal the views of the various writers and speakers on this topic of engineering education, and how to provide for it. The participants in the discussion are all highly trained men and specialists, and consequently what they write is well worth reading. The differences of opinion are, of course, numerous, but they tend to vanish if the division of engineering education among the various classes above mentioned is kept in mind. The book is of importance to educators and of interest to workers in engineering.

Flexible Pole Brackets.

The accompanying cuts illustrate two styles of flexible pole brackets manufactured by the Ohio Brass Company, of Mansfield, Ohio. In the first of these (Fig. 1) is shown the type for wood poles, in which a peculiar form of pole socket and hook casting is employed by means of which the bracket is attached to the pole. The construction of these castings is well illustrated in the enlarged view of these parts. The castings in conjunction with the brace arm, admit of a vertical adjustment of the horizontal arm and give the additional

Fig. 1.—Flexible Pole Bracket.

feature also of allowing the bracket to be easily swung into position on the pole, the pole castings having been previously put up. The flexible end at the outer extremity of the bracket forms a yielding and flexible support for the wire, allowing the car to be operated at a high rate of speed without the evil results heretofore experienced. The trolley wire hanger is suspended on a steel strand cable between the curved arms which extend on either side of it in substantially the same plane, so that it is impossible for the trolley wheel, should it

accidentally leave the wire, to strike it or become entangled in the suspension cable.

Another style for wood poles is shown in Fig. 2, which possesses

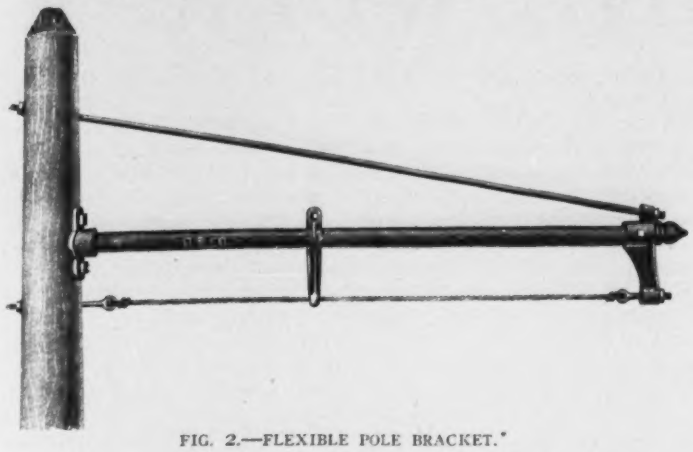


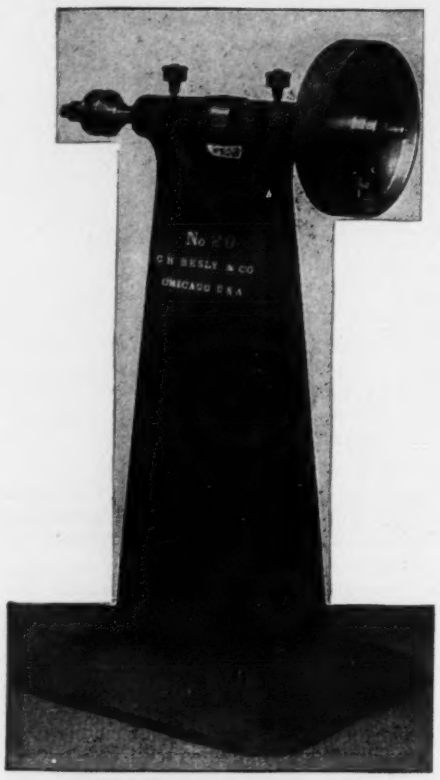
FIG. 2.—FLEXIBLE POLE BRACKET.

several features of merit, where a substantially constructed bracket of this form is preferred.

Band Polishing Wheel.

The accompanying illustration shows a band-polishing wheel, designed to hold one or two emery wheels. The wheels are made of cast iron, an elastic surface being produced by a felt covering. The emery, or other abrasive material, is a piece of emery cloth which is tightened firmly around the wheel. This machine is suitable for shops where skilled polishers are not employed, as well as in those employing skilled labor.

The one-wheel machines are mounted on one end of the spindle, the



BAND POLISHING WHEEL.

other end being suitable for buffing, and are provided with cushioned or hard surface. These polishers are made by Charles H. Besly & Co., 10 North Canal Street, Chicago, Ill.

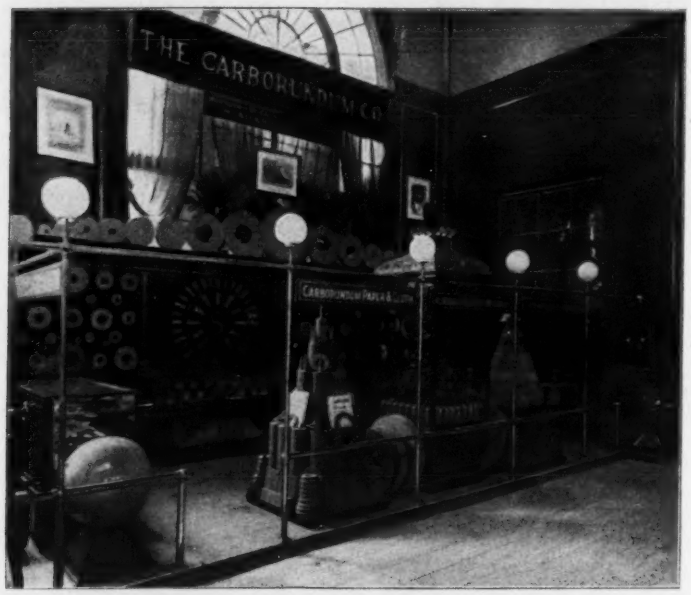
Telephone System for the Manhattan Railway.

An interesting feature in the development of the telephone is shown in the contract just placed by the Manhattan Elevated Railway Company, of New York, with the Lambert Schmidt Telephone Manufacturing Company, New York, for a complete exchange telephone system to be used on the elevated road in New York City. The instruments will be located at the stations and in the offices of the railway company, and replace the former telegraph equipment, which has proved itself too antiquated to meet the needs of rapid service. The entire equipment will consist of a 500-line multiple switchboard and telephones, this system being arranged on the common battery plan with lamp signals. The conditions of the specifications were necessarily severe, on account of the great number of calls required between the different points for train signaling and otherwise, it being estimated that many of these telephones will be used on an average of 2000 times a day—practically continuous service. A telephone man can readily appreciate the severe strain such an enormous traffic would have on a common battery system, and the Lambert Schmidt Telephone Manufacturing Company is to be congratulated on satisfying the authorities of the road that its system fully covers the conditions necessary.

The equipment will present many new features and will, it is said, be a long stride ahead in the telephone art as applied to common battery multiple switchboard systems. An important point in connection with this system is the fact that many of the telephones are located fully 10 miles from the exchange center. There was considerable competition on this contract. The engineers of the road made thorough investigation, and the Lambert Schmidt Telephone Manufacturing Company is exceptionally pleased at securing this contract on merit alone.

A Carborundum Exhibit.

An exhibit of unusual attractiveness is that of the Carborundum Company, Niagara Falls, N. Y., which has its product tastefully arranged in glass cases finished in mahogany. In the center and to the front of the space is a high, square glass case, in which is built up a pyramid of the beautiful carborundum crystals, as taken from the electric furnaces. This pyramid is surrounded by inverted bottles containing the various sized grains. On one side of this case is a pyramid of wheels, built up from the largest, 36 inches diameter, to the smallest dental point, and on the other side is a pyramid built of rolls of paper and cloth and the various forms of these used in polishing and grinding. Along the entire length of this space, at the



CARBORUNDUM EXHIBIT.

back, is a large glass case containing a great variety of wheels of peculiar or special shapes, used for special grinding. Here are also shown sharpening stones, files, rub stones, etc., so tastefully arranged as to make a beautiful display. In a glass case at the end of the space are various specimens of work intended to show some of the uses of carborundum, among which are specimens of granite from all parts of the world, cut glass, porcelain, petrified wood, etc., all polished by carborundum. In front of this case are two beautiful spheres, one of Barre granite and one of Quincy granite, both polished by this substance.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed nominally at 3 per cent; time money was easier during the week, closing at 4¼ per cent for high grade loans, 4½@4¾ per cent for good mixed, and 5 for the more indifferent sort. The stock market was dull, which condition was accompanied by lower quotations for railway shares and by general declines in industrials. Amalgamated Copper and other industrials took a downward turn on liquidation and lack of support, due to an anti-trust decision by New York courts, poor earnings and the absence of information relative to their financial position. Steel stocks were the most active of the industrials, common advancing in anticipation of the favorable statement and declaration of the dividend. After the statement and the announcement of the dividend, quotations receded in sympathy with the break in other industrials. In the traction list, Brooklyn Rapid Transit showed weakness on anticipations of an unfavorable annual report, and closed the week with a decline in price of 6¾ points net. Metropolitan Street Railway also showed weakness, closing at 160¼—a net loss of 4¼ points. General Electric suffered a net loss of 8 points on the week's trading, closing at 250, ex dividend. Western Union held its own pretty well, closing with a net loss of only ¾ of a point. Other electric stocks which showed net losses were American District Telegraph, 1 point, closing at 32, and American Telephone & Telegraph, 2 points, closing at 159, ex dividend. Following are the closing quotations of Tuesday, Oct. 8:

NEW YORK.

	Oct. 1.	Oct. 8.		Oct. 1.	Oct. 8.
American Tel. & Cable..	—	—	General Carriage.....	1	1
American Dist. Tel.....	—	—	Hudson River Tel.....	114	112
Brooklyn Rapid Transit..	64⅛	57⅝	Illinois Elec. Veh. Trans.	—	—
Commercial Cable.....	—	—	Metropolitan Street Ry..	162½	158
Electric Boat.....	16	16	N. E. Elec. Veh. Tran..	—	—
Electric Boat pfd.....	40	40	N. Y. Elec. Veh. Tran...	10	8½
Electric Lead Reduc'n...	2	1⅞	N. Y. & N. J. Tel.....	166	166
Electric Vehicle.....	1	1½	Tel. & Tel. Co. of Am...	5	5
Electric Vehicle pfd.....	4	3	Western Union Tel.....	91	90⅞
General Electric.....	257½	250			

BOSTON.

	Oct. 1.	Oct. 8.		Oct. 1.	Oct. 8.
Am. Tel. & Tel.....	159	157	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	—	—
Boston Electric Light...	—	—	Westinghouse Elec.....	—	—
Erie Telephone.....	39	39	Westinghouse Elec. pfd..	—	—
General Electric pfd....	—	—			

PHILADELPHIA.

	Oct. 1.	Oct. 8.		Oct. 1.	Oct. 8.
American Railways.....	41	40½	Phila. Traction.....	95¾	95¾
Electric Storage Battery.	60	63	Philadelphia Electric....	5½	5¼
Elec. Storage Batt'y pfd.	60	63	Pa. Electric Vehicle.....	½	½
Elec. Co. of America....	7	7	Pa. Elec. Veh. pfd.....	½	½

CHICAGO.

	Oct. 1.	Oct. 8.		Oct. 1.	Oct. 8.
Central Union Telephone.	—	—	National Carbon pfd.....	83	83
Chicago Edison.....	168	160	Northwest Elev. com.....	37	38
Chicago City Ry.....	202	202	Union Traction.....	17½	17
Chicago Telep. Co.....	255	254*	Union Traction pfd.....	58	58
National Carbon.....	18	18⅜			

*Asked.

MR. MORSE IN INDEPENDENT TELEPHONY.—A Boston dispatch referring to the decision of Mr. C. W. Morse, of the American Ice Company, to exercise his option on the stock of the Telephone, Telegraph & Cable Company, states that this decision is taken to mean that the independent telephone interests have decided to make a vigorous fight. Whether or not the new owners will find it desirable to retain control of the Erie Company is still a question. The fact that the Telephone, Telegraph & Cable Company still has in its treasury 23,000 shares of Erie Telephone stock brings a solution of the problem down to one or two methods. Either the former control of the Erie is to be regained or a market will be found for the stock now held. In order to secure control approximately 30,000 shares of stock must be secured. This can be accomplished by paying off the loans to the Old Colony Trust Company syndicate or buying them outright. As long as the loan remains unpaid, that course is naturally impossible, and it would therefore seem that he future control and operation of the Erie Company is included in the deal involving the purchase of the Telephone, Telegraph & Cable Company.

STREET RAILWAY TAXES.—Mayor Tom Johnson, of Cleveland, who has been prominent in street railway management, and who is also an advocate of many changes in existing tax systems, does not favor the mulcting of street railways by exacting percentages of profits, or other considerations, as a way to raise city revenue. In his view, the railroads give much in return for their right of way in the streets. "First," he says, "they lower materially—from a half to a third—previously established passenger and freight rates. Second, they afford people not only their own extra facilities for travel and shipping, but also bring better steam railway facilities with lower rates. Take these two more obvious results, and they alone will more than repay any city for the use of its streets. In a nutshell, every additional facility a city gives people and freights for reaching it, and reaching it cheaper, benefits that city just that much. My advice to all cities is—throw open wide the gates for every urban electric line that she can even encourage into life, that will reach out 20, 30, 40, 50, 60 or more miles into the country."

BROOKLYN RAPID TRANSIT REPORT.—The report of the Brooklyn Rapid Transit Company for the year ended June 30 last was made public on Oct. 8. It shows an increase in the net earnings of the Rapid Transit Company and its constituent companies, as compared with the year previous, of $257,374, but the yield of surplus after charges shows an increase of only $51,081. Following is a summary of the statement:

	1901.	1900.	Changes.
Total receipts	$12,135,559	$11,768,550	Inc. $367,009
Op. ex. and taxes....	7,216,008	7,106,373	Inc. 109,635
Net earnings	$4,919,551	$4,662,177	Inc. $257,374
Charges*	4,341,748	4,135,405	Inc. 206,343
Surplus	$577,803	$526,772	Inc. $51,031

*Included in charges are allowances for damage claims, legal expenses, etc., which in 1901 were $1,157,593, against $913,292 in 1900, an increase of $244,301.

The surplus account as of July 1 stands as follows:

Surplus for year ended June 30, 1901.....	$577,803
Previous surplus	623,426
Total	$1,201,229
Allowance for depreciation, betterments, etc.....	228,678
Balance surplus July 1, 1901	$972,551

THE INTER-STATE TELEPHONE COMPANY, which has acquired by purchase many local telephone companies in Pennsylvania and New Jersey, and which a few days ago bought the Elizabeth Mutual Telephone Company for $30,000, met in Elizabeth, N. J., on Oct. 8, and organized. W. H. Rankin, president of the old company, resigned, and Hugh Hammell, of Trenton, was elected president, and Barker Gummere, Jr., also of Trenton, was elected treasurer. The following were elected directors: Hamilton F. Kean, Barker Gummere, Jr., Henry Loudenslager, William S. Hancock, P. H. Gilhooley, John W. Whalen and Lawrence O'Donnell. The company has decided to spend $100,000 in improving the system.

DIVIDENDS.—The Standard Underground Cable Company, of Pittsburg, has declared a quarterly dividend of 2 per cent. The U. S. Steel Corporation has declared dividends of 1¾ per cent on the preferred and 1 per cent on common.

MINNEAPOLIS GENERAL ELECTRIC.—The Minneapolis General Electric Company reports for the year ending July 31, 1901: Gross earnings, $358,413; operating expenses, $174,288; net earnings, $184,125; fixed charges, $106,135; surplus, $77,989.

Commercial Intelligence.

THE WEEK IN TRADE.—The state of trade throughout the country continues in a very satisfactory condition. While speculative markets showed reactionary tendencies, general distributive trade was active and a heavy volume of business transacted. The best reports of the year come from the iron trade. Bessemer pig iron is 25 cents higher at Pittsburg, at which point the September sales of pig iron were the largest since January. Finished and structural mills are two or three months behind on orders, and rail orders already booked ensure activity far into next year. The leading tube works mills will be run on Sundays hereafter in order to catch up with current work. The business failures for the week, as reported by *Bradstreet's*, aggregate 175 as against 197 the previous week, and 177 the corresponding week last year. The September failures and liabilities were the smallest of any month this year, and the failures for the third quarter of the year are also smaller than in the first or second quarter, as regards numbers. For the nine months period failures and liabilities are larger than one or two years ago, but smaller than in any previous year since 1892. In the metal market,

copper has recovered from its depression and more confidence is shown generally. There has been no change in prices, however, and there does not seem to be any likelihood that there will be in the near future. Manufacturers at home and abroad are utterly bare of stocks, and since there is no prospect of the price breaking, there is more and more buying. Quotations are: Lake, 16½ cents; electrolytic in cakes, wire bars and ingots, 16¼ cents; in cathodes, 16 cents, and casting stock, 15⅞ cents.

WATER SUPPLY FOR CITY OF MEXICO.—The City of Mexico is to have a new water system, which will entail the expenditure of some millions of dollars in the United States for the purchase of electrical machinery, waterwheel equipment, pumping outfits, etc. A syndicate of New York capitalists has acquired the concession granted some years ago by the Mexican authorities to Mr. Wm. MacKenzie, formerly traffic manager of the Mexican Gulf & Monterey Railway, and the contracting firm of Mr. Warren A. Loss, 52 Broadway, New York City, has been allotted the important contract for the construction of the system, which will, it is estimated, cost nearly $6,000,000 American currency, and will mean the purchase of some 35,000 tons of material in the United States. Though the actual details have not yet been settled, it may be stated that the General Electric Company and the Stanley Electric Manufacturing Company will undertake the contract for the supply of the requisite electrical equipment. The former concern's portion of the contract will, it is said, reach a value of nearly $1,000,000. The Pelton Waterwheel Company is to be assigned the contract for waterwheels, and the Worthington branch of the International Pump Company will supply all the pumps. Mr. Loss, accompanied by Mr. John M. Brill, of Chicago, who will act as chief engineer of the work; Mr. E. Abs Hagen, consulting engineer of the Havana sewerage system and chief engineer of the San Antonio, Texas, works, who has been appointed consulting engineer to the syndicate; Mr. A. M. Pierce, the well-known hydraulic engineer; Mr. W. L. Farr, representing the Stanley Electric Manufacturing Company; Mr. O. M. Ticer, on behalf of the Pelton Waterwheel Company, and a representative of the General Electric Company, are now in Mexico making a tour of inspection over the entire line, prior to commencing actual work. The water it is sought to utilize is to be derived from the Almoloya springs, which are located some 40 miles southwest of the Mexican capital and about six miles southeast of Toluca. From those springs a supply equal to 2000 liters of water per second will be drawn and transported by means of canals, pumps and pipe lines over the intervening mountain ridges to the City of Mexico. The magnitude of the undertaking can be more readily appreciated from the following interesting construction data furnished a representative of ELECTRICAL WORLD AND ENGINEER by a member of the contracting firm: The work embraces the construction of a total of 36.6 miles of canals, or 6.4 miles of steel pipe lines (the pipe varying from 10 inches to 48 inches in diameter), the installation of pumping machinery necessitating nearly 27,000 horse-power in order to elevate the needed water to a height of 1456 ft. for the purpose of obtaining a gravity fall to the City of Mexico. Electric energy to operate the pumps will partly be obtained from the Falls of the Malinaltenaco River, some 24 miles southwest of the Almoloya springs. The water in its descent from the plains of Salazar near La Cima, dropping gradually from a height of 2214 ft. on its way to the capital, will furnish 17,500 electrical horse-power, a part of which will be requisite for the operation of the pumps. Of the remainder about 8000 horse-power will be transmitted to the City of Mexico for street lighting, railway and other power purposes, while the rest of the power will be made use of in adjoining towns, mines, and so forth. In the construction of the transmission line no less than 1,400,000 lbs. of copper will be utilized. On completion of the system, which will take two years, the Mexican capital will be furnished with nearly 40,000,000 gallons of pure spring water every 24 hours.

ELECTRICAL ENGINEERING IN BRITAIN.—At the recent International Engineering Congress at Glasgow, the presiding officer was Mr. James Mansergh, president of the British Institution of Civil Engineers. In the course of his opening address, he referred to foreign, and especially American, competition. He said that an alarm had been sounded in their ears of late, warning them that the United Kingdom had touched the high-water mark of the prosperity derivable from manufacturing industries, based upon engineering, or served by it with the means of transport and communication. This might be so. The nation had no royal secret for arresting the revolution of fortune's wheel. The question was whether Britishers could maintain their ground, to say nothing of increasing their lead. Would the engineer in future flourish best in Britain or abroad? One heard much talk nowadays about the British need for more technical education for workers, and of better instruction in the art of living for the people generally, and he was not disposed to disparage this desire for more light. He feared that only too good a case could be made out for the allegation that a mistaken statutory system had discouraged in Great Britain—for the time being, at least—the naturalization and development of electrical engineering on the largest scale. Instead of the electrical and mechanical development of lighting and power plant being undertaken upon a scale proportional to its early promise, the work had to be done by "sample"—every small specimen differing from the others. Long years passed before any English engineer was in a position to give out an electrical power contract amounting to $500,000. Meanwhile competitors in America and on the Continent of Europe had been forging fast ahead. So Englishmen had lost their chance, and would probably have to take other people's electrical plant for some time, instead of striking out their own leading line, as their forefathers did in railway work and shipbuilding years ago.

ELECTRICAL APPARATUS FOR NEW YORK RAPID TRANSIT SUBWAY.—The Rapid Transit Subway Construction Company, of New York, which is to operate the Rapid Transit tunnel when completetd, as already noted in these columns, has let contracts for the steam equipment of its power house. The contract for the electric generating apparatus, it is now announced, has been let to the Westinghouse Electric & Manufacturing Company. This contract includes six 5000-kw, 11,000-volt, three-phase generators of the revolving field type running at 75 r. p. m. at a frequency of 25 cycles. They are rated at 263 amperes per terminal, non-inductive load. The exciters for these machines are of 250 kilowatts, three in number. They will operate at 240 r. p. m. with a voltage of 250. For the substations 26 rotary converters of 1500 kilowatt capacity each are contracted for. These are to give a voltage on the direct-current side of 625 and will run at 250 r. p. m. For starting these rotary converters in the various sub-stations there are to be eight motor-generator sets consisting of induction motors coupled to direct-current generators. The contract also includes 78 step-down transformers of 550-kilowatt capacity each, arranged for giving 390 volts on the secondary terminals, with primary voltages of 9500, 9750, 10,000, 10,250 and 10,500. The alternating generators mentioned will have 40 poles; the frame will be built in seven sections. The fields will constitute the flywheel of the engine. These alternators will be of exactly the same capacity as the generators being built for the Manhattan Railway, New York.

NEW TELEPHONE APPARATUS FOR TOLEDO, OHIO.—The Sterling Electric Company, of Lafayette, Ind., has secured the complete contract for the central office apparatus of the new Home Telephone Company, Toledo, Ohio, consisting of a common battery, lamp signal, multiple switchboard, and comprising also a chief operator's desk, monitor's desk, wire chief's desk, trouble clerk's desk, and information desk. The board will be equipped at each position with the Sterling selective signal four-party line ringing keys. The company will supply also the main distributing board, with its combined "strong" and "sneak" current protective system; and the power board and storage batteries. In this system there is but one battery for talking and signaling and but one relay in the circuit, with consequent advantages. A similar installation is now being put in by the Sterling Company at Houston, Tex., and it is now building equipments for Galesburg and Rockford, Ill., and Peru, Ind.

ELECTRICAL STEERING GEAR.—That the advantages of steering vessels by electricity are receiving a great amount of attention is evinced by the fact that although the "Pfatischer system" has been before the public only a little over a year, the Electro-Dynamic Company, of Philadelphia, reports having orders to equip with it 11 vessels of an aggregate of 110,000 tons displacement. The Eastern Shipbuilding Company, after a careful investigation, has adopted the system for the two mammoth vessels it is now building for the Great Northern Steamship Company. The Electro-Dynamic Company has prepared for general circulation a pamphlet describing the method.

WESTINGHOUSE INTERESTS.—The announcement was made in these columns lately that the Westinghouse interests had purchased 650 acres of land near Stewart station, 20 miles from Pittsburg, on the Pennsylvania Railroad. The Westinghouse companies will, it is now stated, build a town at that point and concentrate there the foundries now operating in Pittsburg, Allegheny and Cleveland. The new plant will employ 2000 men, and will involve an outlay of about $5,000,000. The new town will be called Trafford Park.

THE PHILADELPHIA COMPANY.—A special meeting of the stockholders of the Philadelphia Company will be held on Dec. 4 to vote upon propositions to absorb the Consolidated and Southern Traction companies, the Pittsburg Express Company, and probably the Mellon lines and the Suburban Traction Company. At the same time the capital and bonded indebtedness of the Philadelphia Company will be increased. The exact necessities in this direction will not be known until the various deals pending are consummated.

THE GARTON-DANIELS COMPANY, Keokuk, Iowa, is doing a very handsome business in its kicking coils. One of its latest orders is from the Anglo-American Provision Company at Chicago, a new plant, for 10 coils of 1500 amperes each, with a maximum capacity of 2000 amperes.

ONONDAGA DYNAMO COMPANY, of Syracuse, N. Y., reports its excellent Pan-American exhibit unit as sold, and that inquiries are now in hand for several more.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material from the port of New York for the week ended Oct. 3: Antwerp—7 packages electrical machinery, $205; 21 packages, $1,900. Aden—1 package, $81. Argentine Republic—70 packages, $3,986. British Possessions in Africa—134 packages electrical machinery, $15,430; 93 packages, $4,085. Bristol—16 cases electrical machinery, $2,500. Bradford—35 packages copper wire, $270; 1 case electrical machinery, $145. Bremen—4 cases, $494. Berlin—1 case, $560. British East Indies—37 packages, $1,506; 22 packages electrical machinery, $1,160. British Guiana—43 packages, $746. British Australia—10 packages, $154. Brazil—106 cases, $9,318. British West Indies—21 cases, $623. Central America—17 cases, $549. Chili—1 case, $52. Cuba—1 case electrical machinery, $186; 603 cases, $1,942. Copenhagen—3 cases, $87. Cardiff—1 case, $80. Dutch West Indies—2 packages electrical machinery, $90; 3 packages, $21. Glasgow—38 cases electrical machinery, $2,416; 8 packages, $322. Genoa—2 packages, $467. Hamburg—1 case electrical machinery, $35; 55 packages, $6,738. Japan—251 cases, $26,503; 55 cases electrical machinery, $13,754. Havre—5 cases electrical machinery, $870; 23 cases, $1,759. Korea—8 cases electrical machinery, $145. Leeds—1 case, $85. Lisbon—8 packages, $995. Liverpool—15 packages electrical machinery, $961; 33 packages, $1,649; 275 packages copper wire, $11,060. London—203 packages electrical machinery, $20,673; 125 packages, $3,531. Manchester—1 package, $57; 43 packages electrical machinery, $2,709. Marseilles—2 cases, $260. Milan—1 case, $50. Mexico—231 cases, $19,771; 6 cases electrical machinery, $486. New Zealand—7 packages, $105. Newcastle—4 cases, $200. Philippines—21 cases, $390; 44 cases electrical machinery, $918. Peru—28 cases, $682. Paraguay—68 cases, $687. Riga—8 cases, $1,150. San Domingo—2 packages, $41. St. Petersburg—4 cases, $200. Southampton—42 packages, $5,265; 3 packages, $24. Siam—28 cases, $1,400. U. S. Colombia—2 cases, $41. Venezuela—52 cases, $702.

U. S. FOREIGN COMMERCE.—The record of the foreign commerce of the United States during the eight months ending with August, 1901, shows an increase in imports of $14,000,000, and in increase in exports of $23,000,000, comparing the 8 months of the calendar year 1901 with the corresponding 8 months of 1900. The increase in imports is chiefly in coffee and diamonds. For manufacturers' materials and manufactures ready for consumption the figures of 1901 are strikingly similar to those of 1900. Articles in a crude condition for use in manufacturing were in the 8 months of 1901, $198,702,596, against $198,961,392 in the same months of 1900; articles wholly or partially manufactured, for use in manufacturing, were in the 8 months of 1901, $54,795,758, against $55,994,569 in the same months of 1900; and manufactures ready for consumption were in the 8 months of 1901, $89,850,126, against $89,815,604 in the corresponding months of last year. On the export side the growth is chiefly in agricultural products, which increased $60,000,000, comparing the 8 months of 1901 with those of 1900. Products of the mine show a slight increase, those of the forest and fisheries a slight decrease. Manufactures show a decrease of over $36,000,000 for the 8 months, the figures for 8 months of 1900 being $304,087,505 and those of the 8 months of 1901 $267,853,957, a decrease of $36,233,548. An examination of the detailed statement of exports shows that this reduction is chiefly in copper, iron and steel, and mineral oil. The reduction in exports of copper alone is $18,649,227. The reduction in iron and steel exports is $17,827,830. The reduction in exports of mineral oil is $4,418,625. These three items, it will be observed, show a total reduction of $40,895,672, or about $4,000,000 greater than the net decrease in all manufactures exported, thus indicating that in other lines of manufactures than these three items there has been an increase.

BELL TELEPHONE OUTPUT.—The instrument statement of American Telephone & Telegraph for the month ended Sept. 30 shows:

	1901.	1900.	Changes.	
Gross output	75,578	44,190	Inc.	31,388
Returned	33,482	30,942	Inc.	2,540
Net output	42,096	13,248	Inc.	28,848
Since Dec. 20:				
Gross output	683,171	501,354	Inc.	181,817
Returned	301,289	220,903	Inc.	80,386
Net output	381,882	280,451	Inc.	101,431
Total outstanding.....	2,334,698	1,860,956	Inc.	473,742

PIPE CUTTING PLANT IN NEW YORK.—Crane Company, New York, a branch of Crane Company, Chicago, manufacturers of valves, fittings, pipe, etc., has added to its already large quarters a plant for the cutting, threading and flanging of large and small pipe and for pipe bending at 497 to 505 Cherry Street, connecting in the rear with the pipe storage warehouse at 742 and 744 Water Street, and being opposite the main warehouse at 490 and 502 Cherry Street. Being directly on the East River, and very easily accessible to lighters it is in an exceptionally convenient location for handling heavy work. The building is 125 ft. by 100 ft., the main shop being 110 ft. by 63 ft., and devoted to the cutting, threading and flanging of large pipe. The rear shop is devoted to the handling of small pipe and to pipe bending.

CONTRACTS IN PENNSYLVANIA.—The Iron City Engineering Company, 410 Penn Avenue, Pittsburg, reports having closed two sizable contracts, one at Uniontown, Pa., and the other at College Hill, Beaver Falls, Pa. The latter plant consists of a 50-hp Walrath gas engine, a 30-hp Warren inductor alternator, a switchboard made by the Crouse-Hinds Electric Company, 20 Manhattan enclosed arcs and pole line covering the entire town. The Uniontown contract consists of four 150-hp tandem compound direct-connected Ball engines, four 100-kw Crocker-Wheeler generators, one 6-panel switchboard made by the Crouse-Hinds Company, and conduit and wiring for the 12 floors of the building into which the plant goes. This contract was closed through the office of D. H. Burnham & Co., of Chicago.

TROLLEYS AND COTTON MILLS.—A recent special dispatch from Hartford, Conn., says: A force of 300 workmen is employed on the western section of the interstate trolley line between Danielson, Conn., and Providence, R. I. In a few months the entire line, of about 30 miles, will be completed. The section running from Providence to Foster, R. I., was finished in June. The construction of the road will bring the people of eastern Connecticut into closer touch with Providence than they have ever been before. One result of the building of the road has been the sale to Providence capitalists of three cotton mills at East Killingly, Conn., which were owned by W. R. Klein, of Pennsylvania. The factories have been idle about six years, but they will be started again as soon as needed repairs can be made.

RAILWAY CAR LIGHTING.—It is said that the Atchison, Topeka & Santa Fe Railway Company has adopted the system of the Consolidated Lighting Company and will pay for the 117 cars which are now in operation on the road. Mr. John N. Abott, vice-preisdent of the Consolidated Company, is now in Chicago. Mr. Isaac L. Rice, who is now in Europe, has made a contract with the Great Northern Railroad Company of England for 27 cars. This order has been secured through Vickers, Maxim Sons & Co., fiscal agents for the American Company.

NEW NIAGARA POWER TUNNEL.—The Canadian Niagara Falls Power Company has awarded the contract for the construction of the power tunnel to A. C. Douglass, the cost to be over $500,000. It is to be completed by Jan. 1, 1903, and will be over 2200 ft. long, extending from a point near the head of Cedar Island to the Gorge, a short distance below the Horseshoe Falls. The tunnel will be slightly larger than the tunnel on this side, but it will be of the same form.

BALL ENGINE CONTRACTS.—The Hocking Valley Railway Company, shops at Columbus, have recently placed in operation a 135-hp engine, built by the Ball Engine Company, Erie, Pa., and arranged for direct connection with the generator. The Ball Engine Company has also recently shipped engines for electric lighting to beet sugar factories at Loveland, Colo.; Saginaw, Mich., and Bay City, Mich.

NEW YORK FIRE SUPPLIES.—Bids were opened last week for certain supplies for the New York Fire Department. For furnishing the Boroughs of Manhattan and the Bronx 22,000 ft. of underground cable, the Safety Insulated Wire & Cable Company bid $3,490 and got the contract. The Standard Underground Cable Company bid $4,464, the James Reilly Repair & Supply Company $6,355, and the Manhattan Electric Supply Company, $6,420.

APPARATUS WANTED FOR CINCINNATI.—The C. H. & D. Railway is in the market for an auto car or any device that will give an independent movement of a passenger car for suburban travel. Mr. D. G. Edwards, C. H. & D. Traction Company, Cincinnnati, Ohio, will be glad to hear from any of our readers who can furnish or suggest such apparatus.

ELECTRIC DRILLS.—The Marvin Electric Drill Company, whose plant is located in Canastota, N. Y., has increased its capital stock from $300,000 to $500,000. The company will increase the output of its factory.

SUPPLIES WANTED FOR COLORADO.—The electrical department of the steel works of the Colorado Fuel & Iron Company, Pueblo, Colo., is being greatly enlarged. Catalogues and bulletins of electrical apparatus and supplies for mill work are requested.

THE FEDERAL ELECTRIC COMPANY, 141 Broadway, New York City, is now placing orders for large quantities of line construction material for the Chinese market.

General News.

THE TELEPHONE.

OZARK, ARK.—The Home Telephone Company, recently organized here, purchased the interests of the Ozark Telephone Company. It has a switchboard capacity of 100 drops, and 70 subscribers. It has 30 miles of toll lines, and its charges are $1.50 per month for residences and $2 for business.

VICTORIA, B. C.—According to advices just received here from Japan, France is about to construct a telegraph from Tonquin to Amoy, and thence to Port Arthur, giving France direct communication to the Far East independent of British lines.

LOS ANGELES, CALIF.—The Telephone Hygienic Company has been incorporated; capital stock, $500,000. The incorporators are H. L. Cutter, E. H. Cutter, J. S. Osborn, W. R. Fales and G. J. Leovy.

WASHINGTON, D. C.—Proceedings in equity have been instituted in the Supreme Court of the District of Columbia against the Chesapeake & Potomac Telephone Company by Thomas T. Keane and Nicholas Auth, partners. The court is asked to restrain the telephone company from carrying into effect a threatened refusal to supply the complainants with telephone service, upon payment by the latter of the rental fixed by act of Congress approved June 30, 1898. The action is similar to the hundred or more cases heretofore brought against the same company. Chief Justice Bingham issued an order restraining the defendant pending the disposition of the test case now before the Supreme Court of the United States.

ATLANTA, GA.—The Federal Wireless Telephone & Telegraph Company is making efforts to obtain franchises to operate its system in Georgia. It proposes to establish offices at Atlanta, Augusta and the principal cities and larger towns in the State. It is stated that the Federal Company proposes to compete with the two principal telegraph companies and "flash messages through the air at one cent a word."

COVINGTON, GA.—An independent telephone system was put in operation here during September. This is a competitor of the Bell Company previously established.

STERLING, ILL.—The Whiteside County Telephone Company will make extensive improvements in Morrison as well as Sterling.

HARVARD, ILL.—A. B. Wager, of Woodstock, has sold out his telephone exchange to a syndicate composed of Judge C. H. Donnelly, Geo. W. Field and F. D. Joslyn.

CHICAGO, ILL.—The Lewistown Automatic Telephone Company, of Lewistown, has been granted a charter. Its capital stock is $2,000. Geo. F. Loar, Ralph Hanson and Lucien Gray are the incorporators.

ROCHELLE, ILL.—The stockholders of the Ogle County Telephone Company will vote upon the proposition of increasing the capital stock and also consider the advisability of consolidating with the Independent County Telephone Company of Polo.

CHICAGO, ILL.—About 500 linemen in the service of the Chicago Telephone Company struck on Oct. 1. Among the towns affected are Elgin, Aurora, Joliet, Rockford, Evanston, La Grange, Plainsfield, Lake Forest, Highland Park and Waukegan.

CHICAGO, ILL.—A formal demand has been made on the Chicago Telephone Company by the Illinois Manufacturers' Association that the company shall not charge more than $125 per annum for its service, under the so-called special service contract. This action is preliminary to the litigation which the association will institute against the telephone company to test its right to charge $175 per annum for the service in question.

INDIANAPOLIS, IND.—The Bell Telephone Company has a line from Columbus to North Vernon almost completed.

ORLEANS, IND.—The Georgia Telephone Company has been granted a franchise to build and maintain a telephone system in the town of Mitchell.

MORGANTOWN, IND.—The Morgantown Telephone Company has been incorporated; capital stock, $10,000. The directors are A. M. Fleener, E. M. Woods and H. J. Griffith.

UNION CITY, IND.—Another telephone line has been proposed here. Captain J. B. Ross presented an ordinance for the American Telephone & Telegraph Company, of Indiana, asking the Council for a franchise.

INDIANAPOLIS, IND.—The following-named companies have been incorporated: The Jackson County Telephone Company, capital $5,000; the Logansport Home Telephone Company, capital $150,000; the Cass County Telephone Company, capital $60,000.

LA PORTE CITY, IA.—Otto Wettsteit has been granted the right to erect a telephone exchange in La Porte.

SLOAN, IA.—The Odebolt (Iowa) Telephone Company is engaged in building a line from Mapleton to Smithland.

MONTOUR, IA.—A farmers' telephone line is to be built from Montour to Potter by J. Mages and Levi and James Arment.

TURNER, MAINE.—The New England Telephone Company has purchased the right to erect poles and string wires between Turner and Buckfield.

BOSTON, MASS.—The directors of the Erie Telegraph & Telephone Company are now understood to be planning, in connection with the proposed reorganization of their operating department, for the appointment of a general manager for their entire Southwestern property, who will have charge of their plants in Texas and Arkansas, with the territory divided into divisions practically as at present.

HOWELL, MICH.—The Livingston Home Telephone Company has been incorporated, with a capital stock of $100,000.

WEST LIBERTY, MICH.—A new telephone line, known as the Liberty and Hanover town line route, has been established.

GRAND RAPIDS, MICH.—The Michigan Telephone Company reports a large gain in subscribers during the month of August.

YPSILANTI, MICH.—An independent telephone company has applied for a franchise, and the council is said to look with favor on the matter.

GRAND RAPIDS, MICH.—At a regular meeting of the Citizen's Telephone Company it was reported that the affairs of the company were in excellent shape. A large quantity of materials was requisitioned for and new construction work will be begun on its arrival.

MENOMINEE, MICH.—The City Council has made formal demand on the Green Bay & Lake Michigan Telephone Company to file a bond to insure its good faith in respect to the building of a system in this city. The bond will be promptly furnished by the corporation. Mr. Edw. Munger is meeting with much encouragement in soliciting subscribers. Over a hundred have been secured.

JACKSON, MICH.—The People's Telephone Company of Jackson, recently incorporated with an authorized capital stock of $200,000, is now building its system. The plant will have an ultimate capacity of 2500 subscribers, 1500 drops having already been installed. The lines will connect with those of the United States Telephone Company. The plant includes 80,000 feet of Camp underground conduit, already laid down. Kellogg apparatus is used by the company. Extensions to all outlying towns and throughout the farming districts are contemplated.

ST. PAUL, MINN.—Judge Bunn has filed an order prohibiting the authorities from interfering with the poles and wires of the Northwestern Telephone Exchange Company during the trial of the case of the telephone company vs. the city of St. Paul.

CLINTON, MO.—The Mutual United Telephone Company has been incorporated, with a capital stock of $15,000. The incorporators are S. T. Neill, W. F. Hall and G. R. Lingle.

ST. LOUIS, MO.—The Police Telephone & Signal Company, of St. Louis, capital stock $50,000, has been incorporated by Henry A. Baker, Elisha Morgan, Eugene Buder and others.

TRENTON, N. J.—The Wireless Telegraph Company of America has been incorporated; capital stock, $3,000.

FULTON, MO.—The Missouri & Kansas Telephone Company has ordered materials and latest improved equipment for the reconstruction of its Fulton exchange. This company has also ordered material for the construction of a new toll line north via Mexico. These improvements will be completed early in November.

TRENTON, N. J.—The Bismarck Telephone & Electric Company, of Bismarck, N. D., has been incorporated in New Jersey; capital, $100,000. Incorporators: James Serne, Edmund Mancusi, Benjamin J. Flenchaus.

TRENTON, N. J.—A building which will rank among the best equipped telephone plants in America will shortly be erected by the Interstate Telephone Company in Trenton. The plans, prepared by Architects Brouse & Arend, have been accepted by the board of directors, and bids for the contract will probably be submitted next week.

WATKINS, N. Y.—The Watkins Telephone Company has been formed at this place.

ALBANY, N. Y.—The Oulcout Valley Telephone Company has been incorporated to operate a telephone system in the county of Delaware, N. Y. Capital, $3,000.

WAVERLY, N. Y.—The Waverly telephone system of this place has just finished laying about 1500 feet of underground conduits. New switchboards are being put in which will accommodate about 400 patrons, and other improvements are being made.

ITHACA, N. Y.—The construction of the Century telephone system which is to take the place of the present automatic plant will be begun immediately. The independent company is now rapidly building plants in various cities in this section of the State and will soon be able to make extensive long-distance connections.

ALBANY, N. Y.—The Seneca Falls Home Telephone Company, with a capital of $100,000, has been incorporated to operate in Seneca Falls, Tyre and Junius, Seneca County. The directors are Howard Hendrickson, of Albany; A. G. Lord, J. A. Drake, S. B. R. Rawson, F. H. Sudro, T. M. Brush, F. W. Martin and J. H. Griswold, of Elyria, Ohio.

BELMONT, N. Y.—The telephone situation in this city continues decidedly warm. The Bell and independent interests are bitterly fighting each other, and the townspeople have divided their sentiment between the two companies. The outcome appears to be in favor of the anti-monopoly interests. The Belmont independent company is putting up a spirited fight, and results thus far are extremely satisfactory.

WELLSVILLE, N. Y.—The independent telephone company at Wellsville, under the management of H. W. Savidge, is steadily increasing its business, and the outlook is very satisfactory. The farmers in the neighborhood of Wellsville are rapidly becoming educated to the value of the telephone, and it is expected that within a short time the territory in this neighborhood will be covered with farm lines. The line of the Inter-Ocean Telephone & Telegraph Company is now being rapidly extended west from Wellsville. It will connect with Wellsville, Belmont, Friendship, Cuba, Olean, Salamanca, Little Valley, Cattaraugus, Randolph and Jamestown and all intermediate points, with a view to giving a complete long-distance service for the western part of the State, particularly on points on the Erie Railroad.

MAUMEE, OHIO.—The Bell Telephone Company has opened a fine new exchange building at Maumee.

OXFORD, OHIO.—The Lewisbury Telephone Company, of Preble County, has increased its capital stock from $1,500 to $10,000.

BATAVIA, OHIO.—The Citizen's Telephone Company, of Batavia, has been incorporated, with $50,000 to build a local exchange.

LEWISBURG, OHIO.—The Lewisburg Telephone Company, of Preble County, has increased its capital stock from $1,500 to $10,000, to provide for improvements.

AKRON, OHIO.—Electrical workers employed by the telephone companies at Akron are on strike, demanding 9 hours' work with 10 hours' pay, and recognition of the union.

ZANESVILLE, OHIO.—The Zanesville Telephone & Telegraph Company, one of the new properties of the Federal Telephone Company, has increased its capital stock from $200,000 to $250,000.

CIRCLEVILLE, OHIO.—The new exchange of the Circleville Citizens' Telephone Company is being connected up. Branch exchanges at Williamsport and Ashville will be connected up after Oct. 1.

PORT CLINTON, OHIO.—The submarine cable from Put-in-Bay and Middle Bass Islands to Port Clinton is giving excellent satisfaction. The cable is of an especially constructed type made by the Roebling Company.

CINCINNATI, OHIO.—The Hamilton County Commissioners have voted to install a branch telephone exchange in the county buildings in Cincinnati. The cost of switchboard, six trunk lines and 26 telephones will be $1,060.

BROOKVILLE, OHIO.—The Brookville Telephone Company, of Montgomery County, has been incorporated by O. E. Baker, Enos Shellabarger, J. C. Snyder, W. Z. Miller and N. W. Rinehart; capital stock, $6,000.

WARREN, OHIO.—The Lane Construction Company, of Warren, Ohio, has been formed to build telephone systems. Those interested are W. Hyde, W. T. Griswold, Thaddeus S. Lane, A. I. Powers and W. A. Smith. Capital, $5,000.

TOLEDO, OHIO.—The Toledo Home Telephone Company now has over 5000 contracts for the new service. Construction work is being pushed rapidly in all directions, and it is expected that the system will be completed by June 1, 1902.

CLEVELAND, OHIO.—The Findlay Home Telephone Company, one of the Federal properties, has about 1000 telephones in operation, and it is expected the list will be brought up to 1500 ultimately. About 300 farmers' lines are being connected up.

HAMILTON, OHIO.—The United States Telephone Company will open its long-distance toll stations in Hamilton within a few days. The independent lines have been kept out of this city for a long time through the opposition of the Bell Company.

TOLEDO, OHIO.—The Toledo Home Telephone Company has closed a contract with the Sterling Electric Company for a multiple common battery system switchboard, with 12,000 capacity for its new exchange now under construction. Work is being pushed on the underground district.

MANSFIELD, OHIO.—The independent telephone company at Mansfield will be in full operation about Dec. 1. About 500 houses have been connected up and about the same number are still to be wired. The system will reach a number of small towns in Richland County. This is one of the properties recently acquired by the Federal Telephone Company.

CINCINNATI, OHIO.—The Board of Public Service is in receipt of a request from the Fitzsimmons Telephone Company for permission to string wires. Electrician Weissleder returned the application to the Board without recommendation. This is the independent company which has tried at various times to get a foothold in Cincinnati without success.

COLUMBUS, OHIO.—According to the statement of State Auditor Guilbert, the growth of the telephone business in Ohio the past year has been most wonderful and an immense amount of money has been invested in new companies. The aggregate increase in the valuation of the telephone properties of the State would, he said, be very close to the $2,000,000 mark.

HAMILTON, OHIO.—Within the past few days citizens of Hamilton have cut down over 100 poles erected by the City & Suburban Telegraph & Telephone Association. In response to a general demand, the city Board of Control has revoked the permit granted to the company and ordered all poles removed. The telephone company refuses to do so, claiming that the permit was a contract. The matter will be fought in the courts.

CADIZ, OHIO.—The Harrison County Telephone Company has recently installed an exchange at Jewitt, Harrison County. It has also connected the towns of Jewitt, Short Creek, Adena, and Harrisville with the Cadiz exchange, making in all about 25 miles of toll lines just completed. The Farmers' Telephone Company, and the Harrison County Company are building a joint line to Hopedale which will give them connections through to Steubenville, St. Clairsville and Wheeling, W. Va. The United States Telephone Company (long distance) will build a line from Uhrichsville to Cadiz, which when completed will connect a number of Ohio River towns with the lake cities.

CLEVELAND, OHIO.—F. A. W. Lewin, for the past two years superintendent of construction for the United States Telephone Company, has tendered his resignation, to take effect Oct. 1. He will become general manager of the Peninsula Telephone Company, of Tampa, Fla. Mr. Lewin will be succeeded by W. C. Prickett, at present superintendent of construction for the Dayton Home Telephone Company, Dayton. The new company with which Mr. Lewin will be associated proposes to build an extensive system of independent exchanges and long-distance lines in Florida. It was promoted by Ohio people. The company has incorporated with $300,000 capital stock and the headquarters will be at Tampa. A large exchange will be installed there and auxiliary exchanges will be built in seven towns in the vicinity. These will be connected by toll lines, and a long-distance line will be built on right of way already secured along a railroad, to Jacksonville. Here connection will be made with lines to be built by the independent company in Georgia, giving connection with the Northern States. Small exchanges at Palmetto and Bradentown have been bought up and will be enlarged. The exchange at Tampa will have a switchboard of 1000 drops, with an ultimate capacity of 2500. Poles have been purchased and work has started on the underground lines. Specifications for the equipment of the Tampa exchange are being prepared and bids will be received in the near future.

CLEVELAND, OHIO.—There is considerable speculation among local telephone people as to the exact status of the Frontier Telephone Company, of Buffalo, which has just been incorporated in Albany to build long-distance lines connecting Buffalo, Rochester, Syracuse, Utica, Albany, Poughkeepsie, New York City, Tonawanda, Niagara Falls, Lockport, Dunkirk, Erie, Pa.; Cleveland, Ohio; Jamestown, Elmira, Binghamton, and Hornellsville, N. Y. Judge J. M. Thomas, of the Telephone, Telegraph & Cable Company of America, is mentioned as one of the directors. Mr. H. A. Everett, of the United States Telephone Company, says he has no knowledge of the company, and says he does not see how it can run into Cleveland, in view of the fact that the United States Company has wires extending east to Erie, which take care of all independent business in that section. Mr. B. G. Hubbell, president of the Consolidated Telephone Company, the parent organization of the Interstate Company, which is building long-distance lines in New York State, says that the new company has nothing to do with his companies, despite the fact that Judge Thomas is a director of both companies. The Inter-State lines touch Jamestown, Elmira, Binghamton and Hornellsville, and Mr. Hubbell says he does not see how it will be possible for the new company to build to these points in view of the fact that the Consolidated Company controls the exchanges and gives long-distance connection. It seems quite probable that, unknown to the Cleveland people, Judge Thomas has organized a new company for the purpose of building exchanges at Buffalo and other cities in the Northwestern section of New York State, and the Frontier company is to provide the long-distance connections for such exchanges. It is understood that in the near future an attempt will be made to build an independent exchange at Buffalo.

GUTHRIE, OKLA.—The North American Telephone Company purposes building a line from Texas through Indian Territory and Oklahoma to Kansas City and St. Louis.

RIDLEY PARK, PA.—Council has granted a franchise to the Keystone Telephone Company of Philadelphia.

ALBION, PA.—The Albion Telephone Company, Albion, Erie County, has been incorporated, with a capital of $5,500.

PHILADELPHIA, PA.—The Interstate Telephone Company has been granted a franchise to string wires through Woolwich township, Gloucester County.

HAZLETON, PA.—The Anthracite Telephone Company, a local concern, has voted to merge the line with the Consolidated Telephone Company of Pennsylvania, which will enter into active competition next year with the Bell Company.

PITTSBURG, PA.—Twenty new wires between New York and Chicago, to accommodate increasing telephone business over the Bell long-distance system, have been almost completed between New York and Pittsburg. The American Telephone and Telegraph Company aims to have the new line complete to Chicago by the first of the year. The lines reach Pittsburg by a new route through York, Latrobe, Ligonier and Somerset counties. The cost of the line from New York to Pittsburg will be over $800,000.

HARRISBURG, PA.—A charter has been issued by the State Department to the Cambria County Telephone Company, Cresson township, Cambria county, to operate in Cambria, Clearfield, Center, Blair, Bedford, Somerset, Fayette, Westmoreland, Allegheny, Armstrong, Beaver, Washington, Huntingdon, Mifflin, Juniata, Perry, Cumberland, Dauphin, Lebanon, Lancaster, Chester, Berks, Montgomery, Delaware, Butler and Philadelphia counties; capital, $50,000. Directors: G. S. Mitchell, John Pfeister, F. J. Burgoon, P. C. Hill, Gallitzin; L. T. Sanker, Loretto.

HARRISBURG, PA.—The consolidation of the Pennsylvania Telephone Company and the Central Pennsylvania Telephone & Supply Company went into effect on Oct. 1. The Pennsylvania Telephone Company has its headquarters at Harrisburg, and serves a territory extending from Hazleton to the Maryland line and from Lancaster to Bedford Springs. The Central Pennsylvania Telephone & Supply Company, whose headquarters are at Williamsport, serves a territory embracing fifteen counties, and extending from Forest City to Johnstown. The consolidated company will be known as the Pennsylvania Telephone Company. The headquarters will be at Harrisburg, and the general manager will be M. H. Buehler, at present general manager of the Pennsylvania Company. The Williamsport headquarters of the Central Company will be discontinued.

ALLENTOWN, PA.—The seven independent telephone companies of Eastern Pennsylvania have been merged into one general system, under the name of the Consolidated Telephone Companies of Pennsylvania, operating under the charter of the Schuylkill Valley Telephone & Telegraph Company, of Reading. These independent companies included the Interstate Telephone & Telegraph Company, having lines in operation from Scranton, through Pittston, Carbondale, Wilkesbarre, Hazleton, Mauch Chunk, Leighton, Allentown, Norristown to Philadelphia, where it connects with the Keystone, with which it has a traffic agreement, and a branch line to Trenton, connecting with the independent system of New Jersey and New York. The capital stock is $4,000,000. The present indebtedness is $2,500,000, which will be increased to purchase additional plants and to extend the system. These officers were elected: President, Robert E. Wright, Allentown; secretary, Dr. T. H. Leidy, Reading, and treasurer, C. M. W. Krell, Allentown.

SPARTANSBURG, S. C.—The American Bell Telephone Company is now completing its long-distance line to Asheville, N. C.

EUREKA, S. D.—The Eureka Telephone Company has purchased the Eureka and Mound City telephone system, and will at once extend its lines to Ashley and all the new towns on the Soo line.

NASHVILLE, TENN.—It is reported that the Cumberland Telephone Company may expend several thousand dollars on a proposed building for its executive headquarters.

MEMPHIS, TENN.—Jas. S. Warren, general manager of the Memphis Telephone Exchange (independent system) denies the truth in the rumor that his company will be absorbed by the Cumberland Company.

CANADIAN, TEX.—The Watonga Electric & Manufacturing Company has taken a charter to operate an ice plant, electric plant and telephone lines.

BEAUMONT, TEX.—The Beaumont Telephone Company has begun excavating for the underground conduit on Crocket Street for the new telephone system. The underground conduits will be used throughout the business section, covering a distance of about one mile in the central portion of the city.

NORFOLK, VA.—There is quite a hot telephone fight going on here between the Raleigh, the entirely local company, and the Inter-State. The Bell Company

does not appear to be drawn into the fight. The Raleigh Company says it proposes to have the local business and that this is its field. It offered to buy the local business of the Inter-State, but the latter asked a fancy figure.

RICHMOND, VA.—The Virginia Long-Distance Telephone Company and the consolidated local lines throughout the State, with James R. Kemper at Staunton as president, have sold out to the Bell Company. Many of the smaller companies were induced to consolidate to resist the Bell Company. The Richmond Telephone Company was allied with the Virginia Long-Distance in fighting the Bell Company here and was taken by surprise.

MADISON, WIS.—The Interurban Telephone Company of this city, with a capital of $200,000, has filed articles of incorporation. The company will construct and maintain a system of telephone lines and systems in this State which may later be extended outside of the State. The incorporators are A. L. Hutchinson, H. E. Kelper and Charles Schernecker.

CHEYENNE, WYO.—Work on the telephone line between Cheyenne, Casper and Douglas is progressing rapidly, and the Bell Company hopes to have the line in operation from Casper to Cheyenne before winter sets in.

ELECTRIC LIGHT AND POWER.

SAN FRANCISCO, CALIF.—A project is being considered for the establishment of a jute bag factory in Colusa, with a capacity sufficient to supply all the grain growing territory tributary to that town. It is proposed to organize a joint stock company, with a capital of $100,000. The plant will be operated by electric power.

SAN FRANCISCO, CALIF.—The Quilty water-power, with headwaters in the Mt. Hamilton range of mountains beyond San Jose, Calif., has again come to the surface. It is reported that an engineering party is in the field to make preliminary surveys for an impounding dam, etc. It is claimed that quite an amount of power can be generated at a point 45 miles from San Francisco, and that an Eastern purchaser now holds the water rights formerly held by C. W. Quilty, of San Jose.

COVINGTON, GA.—The city has just completed an electric light plant and lights have been turned on. The system is valued at $15,000.

CHICAGO, ILL.—E. A. Cummings, Charles E. Bolles, Willis S. Herrick, and other citizens of Oak Park, who obtained a franchise last March to furnish heat, light, and power in that suburb under a new system, have taken out articles of incorporation at Springfield. The company is formed with a capital stock of $300,000, under the name of the Oak Park Yaryan Company, and a plant similar to those now in successful operation in several other cities will be built, in which the Yaryan system will be installed.

INDIANAPOLIS, IND.—A manufacturing suburb has been laid out south of this city and incorporated as South Indianapolis. Ten new factories are already secured. The promoters are building a large central electric power-house and electric light plant.

NEW ORLEANS, LA.—The Comptroller will advertise for bids for electric street lighting in this city after the expiration of the present contract, on Dec. 31, 1902. The specifications call for 301 series alternating enclosed arc lamps in the underground district and 2299 lamps of similar construction in the overhead district, a total of 2600 lamps, against 3027 open arc lights now used by the city. The contractor must also furnish 150,000 kilowatt hours' service per annum for incandescent lights, motors, fans, etc., in the public buildings.

WINNIPEG, MAN.—The Winnipeg Street Railway Company and the Ogilvie Milling Company have formulated a co-operative plan whereby they will jointly construct an immense power plant for the transmission of electric power from the Winnipeg River to this city. By this means their own establishments will be furnished and enough surplus electric power generated for the whole city. The plant will cost in the neighborhood of $1,000,000.

BIG RAPIDS, MICH.—The Ferris Industrial School has awarded the contract for a complete electrical equipment for its buildings.

GRAND RAPIDS, MICH.—The Gunn Furniture Company has bought a 50-kw dynamo and other equipment for lighting its factory.

VASSAR, MICH.—Hereafter this town will own the lighting plant, having bought out the private concern operating the lights heretofore.

GRAND RAPIDS, MICH.—The Oriel Cabinet Company, a large manufacturing concern, has just installed a modern 175-kw lighting dynamo to replace the antiquated machine formerly used. The contract was let to a local firm.

BIG RAPIDS, MICH.—A new dynamo has been installed in the lighting plant here and the city is again lighted electrically after a darkness of six weeks. Enclosed arc lamps of the latest type have been put up and better service than heretofore is expected.

ST. LOUIS, MO.—The price paid for a water franchise in St. Louis County at an auction sale before the St. Louis County Court, Sept. 30, was $32,000, and was bid by the Ariel Electric & Manufacturing Company. With the franchise for the water privileges goes the permission for the distribution of gas and electricity for heating, lighting and power purposes.

ST. LOUIS, MO.—Mr. E. G. Bruckman, president of the Imperial Electric Light, Heat & Power Company, received the money a few days ago for the sale of the company's plant and interests to the North American Company. The deal was arranged some time ago and all the details settled. But the final transfer was not made until last week. Mr. Bruckman will act as the representative of the company in this city, and will, it is said, endeavor to bring to a consummation the plans to continue all the lighting, heat and power companies in the city.

HAMLET, N. C.—G. O. Saunders has gone North to buy machinery for the new electric light plant which he will operate here.

FAYETTEVILLE, N. C.—The proposed contract between the city and the Cape Fear Electric Power Company calls for 100-horse-power for street lighting at $2,000 per year, to be furnished on or before Jan. 1, the city retaining an exclusive franchise for all arc and incandescent lights.

WADESBORO, N. C.—Samuel T. Stowe, of Charlotte, N. C., and Mr. Thurston, of Maine, are engaged in surveying the water power at Bluitt Falls on the Pee Dee River, some distance from Wadesboro. It is said that a charter will soon be obtained. The company will then be ready to let contracts for the construction of a dam, and for machinery for transmitting power.

MASSENA, N. Y.—Water was turned into the wheels of the St. Lawrence Power Company's plant at this place on Oct. 1.

PORT JERVIS, N. Y.—A meeting of the Deerpark Electric Light Company, the Port Jervis Gas Light Company, and the Port Jervis Electric Light & Power Company, was held, and a resolution was adopted to consolidate these three companies under the name of the Port Jervis Electric Light, Power & Gas Company. The following directors were then chosen: R. H. Beach, C. R. Horn, R. S. Weaver, Benjamin Ryall and W. A. Parshall. The new board then organized and chose the following officers: President, R. H. Beach; Secretary and Treasurer, C. R. Horn; Manager, R. S. Weaver.

COLUMBUS, OHIO.—Bids have been opened for street lighting. The Columbus Electric Light Company was the only bidder and offered to furnish 600 lights for dark hours only at $74.50 per lamp per year. The city will furnish 400 lights from the municipal lighting plant.

AKRON, OHIO.—The officials of the Canton & Akron Railway Company have applied to the Akron Council for a franchise to operate an electric lighting system in the streets of the city. If the franchise is secured it is the intention to build the power plant for the road near the city and to make a bid for the city's lighting which is now done by the Northern Ohio Traction Company.

SHAWNEE, OKLA.—The Shawnee Electric Light Company will install additional machinery to double its capacity.

OGDEN CITY, ORE.—Council has ordered the Mayor to enter into an agreement with the Portland General Electric Company for a term of six years to furnish arc lights for $7.00 and incandescents for $1.25 per month.

PITTSBURG, PA.—The Burnham Electric Light, Heat & Power Company has been incorporated at Lewistown; capital, $1,000.

HARRISBURG, PA.—Charters have been issued by the State Department to the following corporations: Suburban Electric Company, of Derry Township, Lewistown; capital, $1,000. Granville Electric Light Company, Lewistown; capital, $1,000. Reedsville Electric Light Company, Reedsville capital, $1,000.

CHATTANOOGA, TENN.—The People's Electric Light & Power Company has been organized in this city and a charter will be applied for at once. The incorporators are D. P. Montague, J. H. Warner, Edwin Warner, of Nashville; Frank Spurlock, and W. A. Sadd. The capital stock of the company is to be $200,000. J. H. Warner will be the general manager.

TULLAHOMA, TENN.—The Electric Light and Water Works Commissioners has awarded the contracts for the erection and construction of the water and electric light plants. The General Electric Supply Company, of Atlanta, got the contract for the dynamos and electrical apparatus. The entire contract amounts to $37,500.

ALVIN, TEX.—A move is on foot here to establish an electric light plant for this city. Some of the machinery is already on hand for the plant and if a sufficient number of subscribers can be secured the balance of the machinery will be ordered at once and work of erecting suitable buildings and poles begun.

SALT LAKE CITY, UTAH.—Clements Herschel, the hydraulic authority engaged by the Utah Light & Power Company to report on the feasibility of the proposed dam and reservoir in Ogden Canyon, has completed his labors, and submitted a report favorable to the project. An earthen dam with concrete core was suggested, sixty to seventy feet high, capable of impounding two billion cubic feet of water. The cost is estimated at $250,000.

SALT LAKE CITY, UTAH.—Believing that there is a field in Salt Lake for a new electric light and power company, H. F. Baker, on behalf of himself and a number of Eastern capitalists, is quietly canvassing the situation here with the view of ascertaining the probability of making such an enterprise a paying one. The promoters of the company are confident that they can furnish power and light at a less rate than that charged by the Utah Light & Power Company.

GREEN BAY, WIS.—Arrangements have been completed between the Green Bay and Depere Electric Light & Power companies, whereby the power which has been furnished from Depere from the water power there, will hereafter be generated in this city.

THE ELECTRIC RAILWAY.

LITTLE ROCK, ARK.—The City Council has granted the Little Rock Traction & Electric Company a 50-year street railway franchise.

ANNISTON, ALA.—The Woodstock Iron Company contemplates building an electric railway from its ore mines, at Rocky Hollow, to the Louisville & Nashville Railroad tracks. Residents on the proposed route are opposing the movement.

FRESNO, CALIF.—The Fresno City Railway Company was recently incorporated, with Fresno as the principal place of business. Electric railway lines aggregating 43 miles in length will be constructed. The directors are S. N. Griffith, W. H. McKenzie, F. M. Helm, W. M. Wyatt and W. T. Porter, all of Fresno; H. A. Voorman, H. C. Tilden and A. C. Jewett, of San Francisco, and Claus Kroeger, of Oakland. Capital stock, $500,000; subscribed, $43,000.

PENSACOLA, FLA.—All the motormen and conductors of the Pensacola Electric Terminal Railway went out on a strike on Sept. 29, because the company put a non-union man on one of the cars and instructed a motorman to break him in. The motorman refused and the company discharged him. The union demanded he be reinstated. The company refused to comply with the demand, hence the strike.

JACKSON, GA.—The proposed electric railway has advanced to the point of the granting of a franchise by the city to the Jackson Street Railway & Electric Light Company. The cost of the power plant at Ocmulgee River, equipment and lights is estimated at $100,000.

ATLANTA, GA.—President Jerome Simmons, of the Atlanta Rapid Transit Company, says that his company will build to Marietta, Stone Mountain, Buckhead and Manchester. This will mean the construction of thirty-three more miles of street railway for Atlanta. The two companies already have 142 miles, and this addition would give Atlanta 175 miles of electric railways.

ATLANTA, GA.—The sale of the Atlanta Railway & Power Company, reported recently has been ratified. The purchasers are a syndicate composed of the Old Colony Trust Company of New York, the New York Security Company, and the Mercantile Trust & Deposit Company of Baltimore. The purchase price has not been divulged. The Atlanta Rapid Transit Company is also owned by the above-mentioned syndicate, and Mr. H. M. Atkinson is now practically head of the combined properties worth according to estimate over $12,000,000, the Georgia Electric Light Company being included.

AUGUSTA, GA.—The Augusta Railway & Electric Company has secured the funds to make improvements and to wipe out all its previous liens by the sale of $1,000,000 of 5 per cent first mortgage bonds to the Mercantile Trust & Deposit Company of this city. These improvements have been in progress for some time, and it will take several months more to complete them. They will then represent an outlay of about $4,000,000. New and heavier machinery has been installed by the company, including two 1000-horse-power generators, which are directly connected to the turbine water wheels. Generators for the electric-light station, new boilers and engines and labor-saving machinery are also included. What is said to be the finest switchboard in the South is being installed. The machine shops are fitted up with an electric forge, an electric hammer, wire-insulating machinery, electric drills, electric saws and the usual complement of hydraulic presses, shearing machines, punchers, planers, lathes, emery wheels, etc.

WINCHESTER, IND.—The Eastern Indiana Traction Company has been granted a franchise to run tracks and operate cars through this city. The company is headed by Peter Schwab, of Hamilton, Ohio.

COLUMBUS, IND.—The Pennsylvania Company has begun the wiring of its line between this city and Indianapolis, for the purpose of running electric cars in competition with the Indianapolis, Greenwood & Franklin road. It is claimed that the railroad people find this necessary, as the electric line has taken a great part of the passenger and local freight traffic between Indianapolis and this city.

SHELBYVILLE, IND.—The Shelbyville & Southeastern Traction Company has been organized here and incorporated with a capital stock of $600,000 to build a line from this city to Indianapolis. The incorporators are Cleveland, Ohio, capitalists, headed by Ed. K. Adams. The franchises have been secured from both Shelby and Marion counties and private rights of way secured where necessary. The company has also let the contract to construct the line to a Chicago construction company, and work is to be commenced at once.

MILLBURY, MASS.—The promoters of the proposed trolley line from Worcester to Providence have petitioned for a charter in this State. A charter will be asked for the passage of the road in Rhode Island. The company will be capitalized for $200,000.

HOLLAND, MICH.—There is now quite a dispute here between the Mayor and the street railway company concerning the latter's attempt to put up new feed wires through the main thoroughfares. It looks as if the company would come out on top because it threatens to tie up the entire line if the Mayor's orders are enforced.

RALEIGH, N. C.—It is reported that the Raleigh electric street car line will be extended the entire length of Fayetteville Street.

UTICA, N. Y.—The Utica Belt Line and Suburn, Utica & Mohawk; Utica & Deerfield; Oneida Street Railway, and the Herkimer, Mohawk, Ilion & Frankfort Railway have been consolidated. The name of the consolidated company will be the Utica & Mohawk Valley Railway and the capitalization will be $3,000,000. All the stock has been taken by the incorporators.

ALBANY, N. Y.—The Westchester Traction Company has been incorporated, with a capital stock of $200,000, to operate a street surface electric road from Ossining to Pleasantville, Westchester County, a distance of five miles. The directors are Thomas F. Barrett, Harry M. Shaw, H. C. Willes, C. J. Harrington, D. E. Shaw, and P. C. Ackerman, of New York City, and R. E. Farley, G. N. Bissell, and J. M. Farley, of White Plains.

NEW YORK, N. Y.—The Edison Electric Illuminating Company has completed the work of laying a three-inch lead pipe, containing three conductors across the Bridge in order to connect with the feed wires of the Brooklyn Rapid Transit Company. The railroad company has been unable to secure sufficient power to operate its cars to the suburbs since the destruction of the Kent Avenue power-house. The current will be furnished by the Edison Company from its power-house in Manhattan. The cables will carry an alternating current of 6600 volts.

NEW YORK, N. Y.—Hearings took place last week before the State Railroad Commission on the application of the New York & Portchester Railroad Company to be allowed to build a four-track electric railway from 132d Street and the East River to Portchester. William C. Gottshall, president and engineer of the road, said that the road would be operated on the third-rail system. William Barclay Parsons, chief engineer of the Rapid Transit Commission, said he considered the proposed speed of twenty-one miles with ten stops in thirty-one minutes practicable. The cost of right of way for the road is estimated at $1,600,000, and that of construction and equipment $7,000,000. This road is intended to be operated in connection with the New York Rapid Transit Subway system.

CANTON, OHIO.—After a long fight the City Council of Canton has agreed to grant a franchise into town to the Northern Ohio Traction Company for its Akron, Massillon and Canton line, now under construction.

WARREN, OHIO.—The Mahoning Valley Railway Company is planning to establish a summer resort at Leavittsburg on the line being built from Warren. This will be on the through line from Cleveland to Warren.

HAMILTON, OHIO.—Five injunctions have been issued against the Millcreek Valley Railway in Hamilton and the road is effectively barred from building its line in Hamilton until the disputes are settled by the courts.

COLUMBUS, OHIO.—The Akron & Barberton Belt Line Railway Company and the Akron South Side Belt Line Company, Akron, have consolidated under the name of the Akron Belt Line Railway Company. The capital stock is fixed at $25,000.

XENIA, OHIO.—Officials of the Springfield-Xenia division of the Pennsylvania Railway announce that the branch will be equipped and operated by electricity within two months. Wire and heavy rails have been ordered. The road will be operated on the third rail system.

NEWCOMERSTOWN, OHIO.—The power for the operation of the Newcomerstown, White City and Uhrichsville electric railway will be obtained from a pair of horizontal turbines of 125 horse-power. A duplicate plant, of the same power, will be installed to be run by a gas engine. The company was recently incorporated by C. W. Walker, G. W. Reed, W. P. Sherron, Fred Elbery, J. L. Hillyer, Albert Elbery, W. J. Anderson and G. A. Parr. The capital stock is $10,000.

CLEVELAND, OHIO.—It is promised by Christmas sleeping cars will be run on a trolley line between Cleveland and Detroit on the line of the Lake Shore Electric Company. This is part of the system developed by the Mandelbaum-Pomeroy syndicate, which is ultimately to run from Detroit to Pittsburg.

CLEVELAND, OHIO.—New negotiations are in progress for the consolidation of the Columbus, Delaware & Marion Railway promoted by E. J. Lattimer and J. W. Holcomb, of Cleveland, and the Columbus, Delaware & Northern Traction Company, which is promoted by the Appleyard syndicate of Columbus.

CINCINNATI, OHIO.—Connection is expected to be made with some of the various suburban lines radiating from this city with the newly incorporated Indianapolis, Shelbyville & Southwestern. The construction of the road will be begun at once and it is expected that it will be finished by June 1. The line will be 26 miles long and will extend from Indianapolis to Shelbyville.

CLEVELAND, OHIO.—E. P. Roberts & Company have the contract for building the Muncie, Hartford & Ft. Wayne Traction Company's line in Indiana, which for the present will be about 30 miles in length. S. M. Hexter, of Cleveland, is president of the company and Messrs. J. G. Gilchrist and S. Osborn, of this city, directors. E. P. Roberts & Company are at present getting out specifications and contracts for grading, and line work will be let during the next two weeks.

SCRANTON, PA.—The employes of the Scranton Railway Company struck on Oct. 1 because two of their number were recently discharged for alleged dishonesty. The Union demanded their reinstatement, and the refusal of the company to do so resulted in the strike. Later reports state that the strike is a practical fizzle, and that it is not receiving favorable public sentiment. The company, it is stated, is running cars with fair regularity.

READING, PA.—The employes of the Union Traction Company in this city were called out on strike on the evening of Oct. 5. The trouble is the result of the discharge of two men and the inability of the four arbitrators to select the fifth. The company claims to be prepared to meet the trouble, and asserts that it has plenty of new men to take the places of the strikers. Only a few of the men obeyed the call, and these were promptly discharged. A majority of employes, it is stated, have renounced the union, and the road will be non-union hereafter.

BLOOMSBURG, PA.—A charter has been granted to the Shickshinny & Huntingdon Valley Electric Railway Company, and the Borough Council, at its last meeting, granted the company right of way through the streets of the borough. The road will connect Shickshinny, Harveyville and Huntingdon Mills, and will open up a rich farming district through which there is at present no railroad. It is understood that eventually the lower end of the county will be thus connected. The officers of the company are: President, R. M. Robinson; Secretary, R. M. Tubbs; Treasurer, E. W. Garrison; Directors, N. B. Rutter, E. S Stackhouse, J. D. Woodworth, C. B. Harned, Dr. J. B. Hess, J. C. Harvey, Captain John Robinson, all of Shickshinny.

NASHVILLE, TENN.—The Nashville Railway Company refused to employ the 150 motormen and conductors who joined the union recently and quit work pending a settlement of the question as to signing a surety bond which the men say is intended to hold them responsible for accidents occurring while on duty. The service is badly crippled.

CHATTANOOGA, TENN.—Major J. H. Warner and others interested in the Chattanooga Electric Railway Company, have applied for a charter for an electric company which will furnish power for manufacturing purposes and to the street railway company. This plan was adopted instead of enlarging the present power-house of the railway company, which would otherwise be required because of the extension of the road into various suburbs hitherto not reached by the line, and which are now being built.

PARIS, TEX.—The Paris Transit Company, of Paris, has been incorporated; capital stock, $100,000. The incorporators are: John A. Porter, F. N. Stormont, S. B. M. Long, R. W. Wortham, of Paris, and W. F. Little, of St. Louis.

SALT LAKE CITY, UTAH.—One of the final steps in the merging of the properties of the Salt Lake Railway Company, the Rapid Transit Company and the Utah Power Company into the Consolidated Railway Company, was taken on Sept. 27, in the filing of a first mortgage for $3,000,000. The bonds run for twenty years, drawing interest at 5 per cent.

RICHMOND, VA.—The Richmond & Petersburg Electric Railway Company expects to begin operating its line about the middle of November. All grading has been practically completed. Work is proceeding from the Richmond terminus.

NEW INDUSTRIAL COMPANIES.

THE P. T. MOTOR COMPANY, of East Orange, N. J., has been incorporated to manufacture motors; capital, $100,000. Incorporators: Albert R. Palmer, Edward T. Magoffin, John R. Turner.

THE ELECTRICAL INVESTMENT COMPANY, of Fort Wayne, Ind., has been incorporated with $100,000 capital stock. The company will buy bonds and stock of electric companies. All of the incorporators are Ft. Wayne men.

THE EMPIRE MOTOR CARRIAGE COMPANY, of New York City, has been incorporated at Albany, with a capital of $250,000. The directors are Bradley S. Teale, of Oneida; George B. Gurley, Henry T. Clinton, Thomas P. Payne and William A. Fitzpatrick, of New York City.

LEGAL.

FIGHTING OVER A SIGN.—The closing days of the Pan-American Exposition have been enlivened by a brisk fight in the courts at Buffalo between the Crocker-Wheeler and Westinghouse companies over a large lamp sign which the latter concern had put up in Electricity Building, and which was alleged by the Crocker-Wheeler Company to infringe on its territory. The Westinghouse people held that their sign was in place before the space below had been occupied, but the Crocker-Wheeler Company obtained a peremptory order for the sign's removal. The Westinghouse Company have complied with the mandate of the court, but in cutting off part of the sign have done a very clever piece of advertising, as whoever visits the building makes inquiries as to the missing letters and carefully spells them out for himself. Everybody seems happy over the result.

IMPORTANT BOOSTER LITIGATION.—Three bills were filed in Cleveland on October 7 in the United States Circuit Court for the Northern District of Ohio by the Electric Storage Battery Company, of Philadelphia, through its counsel, Mr. John R. Bennett, of New York City, against Sipe & Sigler, the Cleveland Electric Railway Company and the Cleveland & Chagrin Falls Railway Company, for infringement of the H. Ward Leonard so-called "Booster" patent, owned by the Battery Company. The outcome of these cases will be watched with keen interest by electric railway owners and builders throughout the United States, as they involve broadly the right to use what is known as the "booster" system, which is now regarded as so necessary in the application of storage batteries to electric railways. It is understood that these three suits in the Ohio District are preliminary to others to be brought in other jurisdictions.

OBITUARY.

THE LATE E. P. GLEASON.

ELLIOTT PERRY GLEASON. Last week we noted the death of Mr. E. P. Gleason, president and founder of the well-known concern in this city bearing his name, and are now able to present a recent portrait. Not only was he one of the pioneer inventors in the field of gas illumination, but in that of glass manufacture for lighting purposes. When electric illumination developed his company was again one of the first to make fittings and appliances solely intended for that new branch of industry, and to his long list of inventions he added globe holders, insulating joints and many fittings now standard. This again required new developments in glassware, and the Greenpoint factory started in 1883, one of the largest in the East, is far too small for the redoubled demands upon it. Mr. Gleason was what could be called a "business philanthropist." He disliked to see idle factories, and where a business appealed to him as one affording plenty of work, even if not very profitable to himself, he was prepared to finance it and "start the wheels." He had a faculty of choosing the right sort of lieutenants to aid him in his many ventures, which, being widely separated, could not all receive his personal attention. He was always easy to approach and took delight in going around among his men. Employing at least 1,000 hands, he knew the names of most of them, and could greet them intimately on the chance meeting of the moment. Though employing both union and non-union help—according to the location and conditions—Mr. Gleason never had a strike or any falling out with any of his working men, and any complaint, minor or otherwise, received his immediate attention, and if well founded was promptly remedied. Mr. Gleason was called "the workingman's friend"—a title given him by a newspaper twenty years ago. This title has stuck to him, and no action of his ever caused him to forfeit it. His life well typified the restless, acute, indefatigable, successful New England inventor, whose genius lies at the base of so much that is finest and best in American achievement in the arts and sciences. Without such men, no art can advance; with their aid any art will make giant strides to perfection. A number of nephews who were associated with Mr. Gleason in busineess will conduct the various branches as heretofore.

PERSONAL.

MR. JOHN A. GRIER has an interesting article in the Chicago *Daily News* on the respective electrical features, etc., of the Chicago World's Fair and the Buffalo Pan-American.

MR. LUTHER STIERINGER read a paper before the American Institute of Architects at Buffalo, during their convention last week, on "Electrical and Decorative Work in Connection with Exposition Buildings," in which a number of interesting and suggestive features were brought out.

MR. ROBERT HAMMOND, the veteran English electric lighting advocate, whose activity in the field of electrical engineering has continued with incessant vigor for the last twenty years, has been a visitor to this country to study electrical railway development, and returned to England by the "Majestic" on Wednesday, after a rapid participation in the American Street Railway Convention by way of bonne bouche. He met a number of old friends and made many new acquaintances during his all too brief stay in America.

EDUCATIONAL.

LECTURES ON ELECTRICITY.—Special attention is paid to electricity, in the course of free lectures announced by the New York Board of Education. Following is the programme: Principles and Practice in Electrical Engineering, by W. W. Ker, illustrated by stereopticon views and experiments. At the Young Men's Institute, No. 222 Bowery—Oct. 9, Magnetism; Oct, 16, Generation of Electricity; Oct. 23, The Electric Motor and Its Application; Oct. 30, Electric Arc Lighting; Nov. 6, Incandescent Electric Lighting; Nov. 13, Electro Plating and Electrotyping; Nov. 20, Wireless Telegraphy; Nov. 27, Electric Bells, Batteries and Alarms; Dec. 4, Electric Heating and Its Application; Dec. 11, Alternating Currents; Dec. 18, The Electric Storage Battery and Its Application. At the West Side Auditorium, No. 318 West 57th Street—Oct, 18, How Buildings Are Wired for Electricity; Oct. 25, Electrical Units and Measurements; Nov. 1, Thermo Electric Generators; Nov. 8, Recent Development in Wireless Telegraphy (Marconi's syntonic system); Nov. 22, Application of Electricity in Mining; Nov. 29, Electric Railways (Third Rail and Sectional System); Dec. 6, Application of Electric Signals; Dec. 13, The Modern Steam Engine.

Trade Notes.

ASSIGNMENT.—The Scott Automobile Company, of St. Louis, Mo., has made an assignment. The company was organized about a year ago to manufacture electric motors and automobiles.

SWEDEN.—The sun never sets on Cross oil filters. The Burt Manufacturing Company, of Akron, Ohio, the manufacturer reports them in use in 28 different countries. A shipment of them was recently made to Stockholm, Sweden.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is advertising a receptacle which it claims is the only article which will make a wet job dry. It is the Newgard combined waterproof globe and receptacle, for which this company is general agent.

PAN-AMERICAN MAP.—The American District Steam Company, of Lockport, N. Y., is distributing, with its compliments, a pocket folding map of the Pan-American Exposition and the city of Buffalo. These maps will be found very serviceable to visitors to the Exposition.

PRESSES.—The E. W. Bliss Company, Brooklyn Borough, New York City, illustrates its complete line of drawing presses and spinning lathes in a neat 48-page pamphlet, just issued. The principal features of construction of many of the machines are briefly described.

REMOVAL NOTICE.—The Chicago office of the Cutler-Hammer Manufacturing Company, formerly at No. 403 Fisher Building, has been moved to Rooms 1232 and 1233 Monadnock Block, in order to facilitate its increased business in rheostats and devices for motor control. The office will be in charge of Mr. C. H. Norwood.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, has recently got out a novelty in the medical battery line. It is complete, with all attachments, and is contained in an aluminum case seven inches long and two inches in diameter. It is most compact, and the latest thing of its kind on the market. It can be easily carried in the pocket.

FALCON SPECIALTIES.—The October bulletin (No. 8) of the Falcon Electric Manufacturing Company, New York, is devoted to that company's specialties, which include panel boards of all sizes, fuse blocks, lugs for knife switches, attaching plugs and flush receptacles, "Falcon" desk and bracket fans, "Falcon" motors and "Falcon" arc lamps. The pamphlet includes price lists and illustrations of these goods.

RUBEROID ROOFING.—This article has been in the market for many years, and is very well known to manufacturers and others as a reliable and serviceable roof covering. It is manufactured by the Standard Paint Company, 100 William Street, New York, and is one of the well known P. & B. products. The company has just brought out a neat leaflet in which it gives all the facts about Ruberoid roofing that any interested person cares to know, besides copies of many testimonial letters.

THE BENJAMIN ELECTRIC MANUFACTURING COMPANY, Chicago, which makes series and multiple clusters and electrical specialties, has had unusual success in its sales for September, its expectations having been more than realized. As a result, its factory facilities have had to be increased in order that it may keep up with the orders. Very many people who have used its clusters have expressed themselves as highly pleased with them and have evinced their sincerity by forwarding duplicate orders.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED OCT. 1, 1901.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

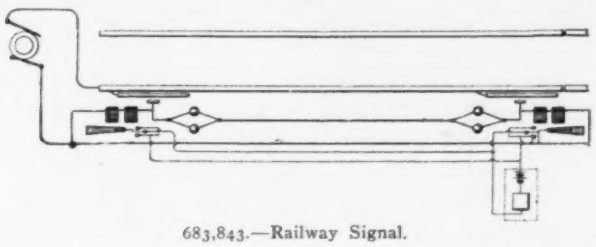
683,235. MOTOR GENERATOR; René Thury, of Geneva, Switzerland. App. filed Jan. 11, 1900. The apparatus consists of a stationary armature and a hollow vertical shaft carrying differentially-wound revolving field coils; a centrifugal governor on the shaft cuts out the differential coils of the field for the purpose of controlling the speed of the apparatus; the commutator is stationery and the brushes are secured to the revolving shaft. (Issued Sept. 24.)

683,432. APPARATUS FOR LIGHTING VEHICLES BY ELECTRICITY; B. Bernstein, New York, N. Y. App. filed Nov. 28, 1900. The rotation of the axle of the vehicle operates the dynamo shaft through the medium of reciprocating friction clutches, so devised that constant rotation is imparted to the dynamo in one and the same direction whichever way the axle is running.

683,444. CIRCUIT CONTROLLER; W. W. Cower, New York, N. Y. App. filed Jan. 8, 1901. Details.

683,451. ELECTROMAGNET; E. B. Ellicott, Chicago, Ill. App. filed May 26, 1900. Consists in mounting the pole pieces fixedly upon the base-plate of the relay or other instrument and winding the coil upon a separate detachable core. The pole pieces are made the terminals of a circuit and the two ends of the detachable core are electrically insulated from one another and form the terminals of the helix. This facilitates replacement of a burnt-out coil.

683,460. SYSTEM OF DISTRIBUTION; W. S. Gould, New York, N. Y. App. filed Jan. 31, 1901. A main generator and storage battery and work-



683,843.—Railway Signal.

circuit connected thereto, an independent generator and switching means for transferring cells of the storage battery from the circuit of the main generator to the circuit of the independent generator while maintaining the said two circuits in disconnected relation.

683,480. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; F. R. McBerty, Evanston, Ill., and J. L. McQuarrie, Chicago, Ill. App. filed Aug. 19, 1898. (See page 597.)

683,494. BATTERY PLATE SEPARATOR; Henry C. Porter, Chicago, Ill. App. filed Feb. 5, 1900. A flat perforated sheet of insulating material with vertical strips of insulating material secured on both sides of the plate at the edges and to the middle of the plate.

683,505. TELEPHONE CIRCUIT; C. E. Scribner, Chicago, Ill. App. filed Jan. 20, 1900. (See page 597.)

683,521. ANCHOR FOR PIPES OF CONDUITS IN ELECTRICAL OR OTHER SYSTEMS; L. Teuscher, Laporte, Ind. App. filed May 16, 1901. The pipes inside of the conduit engage with the conduit at intervals so that end thrust on the pipe will be transmitted to the conduit.

683,534. TROLLEY; E. A. Wakefield, Pelham, Mass. App. filed May 31, 1901. Details.

683,558. MANUFACTURE AND REPAIR OF INCANDESCENT ELECTRIC LAMPS; F. Fanta, London, Eng. App. filed May 26, 1900. The filament of an old lamp is regenerated by opening the globe and circulating a current of hydro-carbon vapor through the globe simultaneously with the passage of current through the filament.

683,564. ELECTRIC APPLIANCE FOR TREATMENT OF DEFECTIVE HEARING; W. H. Loop, Cohoes, N. Y. App. filed Sept. 29, 1900. Copper and zinc wire are coiled together in the form of a tube for inserting into the ear.

683,569. AUTOMATIC SIGNALING SYSTEM FOR TELEPHONE EXCHANGES; J. L. McQuarrie, Chicago, Ill. App. filed Jan. 26, 1901. (See page 597.)

683,579. CUT-OUT BLOCK; H. O. Swoboda, New York, N. Y. App. filed Jan. 18, 1901. Details.

683,601. ELECTRIC BRAKE; E. A. Henry, Cresline, Kan. App. filed Sept. 17, 1900. A series of magnets are mounted to move on a rod or shaft, the latter being provided with shoulders to limit the movement of each magnet. The movements of the magnets apply or release the brake.

683,616. ELECTRICAL AUTOMATIC SAFETY HAND CONTACT FIRING KEY; T. J. Moriarty, Newport, R. I. App. filed Jan. 17, 1901. A spring separated split handle which when squeezed will close a circuit.

683,621. RAILWAY SIGNALING; W. G. Roome, Jersey City, N. J. App. filed Feb. 25, 1901. Storage batteries along the roadway for operating the signals are charged by dynamos operated by the moving train through circuits made up in part of the track rails.

683,622. ELECTRICAL MEASURING INSTRUMENT; H. O. Rugh, Sandwich, Ill. App. filed July 24, 1901. A Wheatstone bridge apparatus wherein by a peculiar arrangement of circuits the indicator in the bridge wire is dispensed and an indicator in one of the legs takes its place.

683,631. TELEPHONE RECEIVER; Hubert Lawrence White, Utica, N. Y. App. filed March 22, 1900. The improvement consists in attaching the permanent and electro-magnets to an inner shell or cup which is screwed down into the outer case, the cap clamping the diaphragm to the edge of the inner cup, and abutting against the shoulder of the outer case.

683,639. PROTECTIVE APPLIANCE; W. P. Crockett, Chicago, Ill. App. filed June 12, 1901. One end of a fuse is attached to a spring so that when the fuse is weakened, the spring will break and separate the parts.

683,657. ELECTRIC BURGLAR ALARM; A. J. Noreen, Chicago, Ill. App. filed March 9, 1901. Details.

683,663. DEVICE FOR TAKING OFF CURRENT FOR ELECTRIC TRAMWAYS; A. Reinecke, Neviges, Germany. App. filed April 12, 1901. The trolley wheel is supplanted by two balls between which the wire rests, flanges being used to prevent the wire from becoming displaced.

683,668. ELECTRICAL MEASURING INSTRUMENT; N. H. Suren, Needham, Mass. App. filed Feb. 16, 1901. Means for regulating the magnetic field containing the magnetized needle.

683,680. ELECTROMASSAGE DEVICE; L. J. Chapman, Columbus, Ohio. App. filed July 31, 1901. Details.

683,689. ELECTRIC OPERATION OF ELEVATORS; J. D. Hilder, Yonkers, N. Y. App. filed April 26, 1901. In a system where the elevator is controlled by means of push buttons, at each floor, means are provided for allowing the passenger to safely make his exit from the car before the latter can be moved by the operation of a push button at another floor.

683,690. APPARATUS FOR STERILIZING DISEASE GERMS; C. M. Johnson, New York, N. Y. App. June filed 13, 1900. A source of current and a pair of divided electrodes constructed and arranged to project the violet rays through diseased portions of the body.

683,692. PUSH BUTTON; C. J. Landin, Boston, Mass. App. filed Feb. 9, 1901. Details.

683,709. CONTROLLER FOR ELECTRICAL APPARATUS; G. W. Schilling, Philadelphia, Pa. App. filed May 16, 1901. To prevent the current from being thrown on too rapidly, the handle of the controller is caused to rise and fall over obstructions fixed in its path.

683,759. ELECTRIC SIGNALING APPARATUS; F. B. Herzog and S. K. Wheeler, New York, N. Y. App. filed Jan. 29, 1886. The first claim describes the invention as follows: In a signaling system, circuit controllers at two or more sub-stations, and at a central station, receiving mechanisms, each controlled by a magnet, each normally controllable from either sub-station, together with a circuit to each sub-station; the magnets which control the receiving mechanism being fewer in number than the number of these circuits; and automatically operated devices common to the circuits connecting with the receiving station, and acting, when one distant apparatus has secured control, to prevent interference from another station.

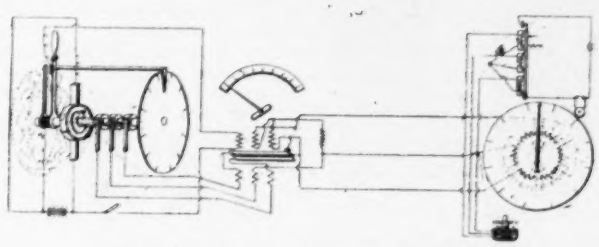
683,783. CROSSING SIGNAL FOR RAILWAYS; F. McBrien, Newark, N. J. App. filed April 19, 1901. An auxiliary circuit in connection with the other circuits, keeps the signal in operation, if a second train happens to be in the protected region before the first train leaves it.

683,831. ELECTRIC METER; V. Arcioni, Spoleto, Italy. App. filed June 5, 1901. Means for actuating a signal device simultaneously with the decrease of the current through the instrument.

683,836. PROCESS OF MAKING PAPER PULP; T. C. X. A. Berget, Paris, France. App. filed Dec. 5, 1900. (See page 591.)

683,839. CONTACT SHOE CARRIER; J. F. Bjurlund, Richmond Hill, N. Y. App. filed Dec. 5, 1900. An elliptical spring of peculiar construction is inserted between the bracket and the shoe.

683,843. RAILWAY SIGNAL; F. E. Button, New York, N. Y. App. filed Aug. 9, 1900. The circuits operating the signals are such that trains enter-



683,872.—Electrical Signaling Apparatus.

ing opposite ends of a block at the same instant will be apprised of the fact, notwithstanding that each train is capable of setting the signals at both ends of the block on its entry thereto.

683,845. APPARATUS FOR THREADING CONDUITS; T. A. Callahan, St. Louis, Mo. App. filed Jan. 17, 1901. A threading device which can be moved through the conduit in either direction at will.

683,849. INDICATING MECHANISM; J. P. Coleman, Edgewood Park, Pa. App. filed Nov. 14, 1900. Details.

683,872. ELECTRICAL SIGNALING APPARATUS; A. U. Alcock, London, Eng. App. filed Jan. 21, 1901. This invention consists of various improvements in signaling apparatus of the kind in which the transmitting and receiving instrument are connected by three wires, and the indicator of the receiving instrument is caused to move synchronously with a movable part of the transmitting instrument.

683,876. GAS LIGHTER; S. Boronow, New York, N. Y. App. filed July 5, 1901. A portable device consisting of a handle containing a battery, and an incandescing wire to be heated upon the closing of the circuit by a push button attached to the handle.